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ECONOMIC ANALYSIS OF EFFLUENT GUIDELINES: MEAT PACKING INDUSTRY

DEVELOPMENT PLANNING AND RESEARCH ASSOCIATES, INCORPORATED

PREPARED FOR
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The economic impacts of proposed effluent guidelines on livestock slaughtering and meat packing (slaughter and processing) plants are assessed. The analysis includes description and statistical compilations regarding the number, location and characteristics of types of firms and plants; financial profiles, investments, operating costs and returns for industry segments analyzed; evaluation of product prices, pricing mechanisms and price relationships; description of analytical procedures employed; evaluation of costs of proposed effluent treatment technology; economic impacts resulting from imposition of effluent guidelines in terms of effects on prices, industry returns, volume of production, employment, community economies, and foreign trade. Limits of the analysis are stated.

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Imposition of BPT level controls (1977) would have a negligible impact on the industry if the current effluent control status (virtually all plants having primary and secondary treatment facilities in place) is as reported and if control costs are as stated by EPA. Compliance with BAT (1983) level controls could result in the closure of 65-70 commercial plants (10 percent of plants not on municipal sewers) under conditions assumed in the analysis, with a loss of 2,700-2,800 jobs, a reduction of $21-22 million in payrolls and corresponding impacts on affected communities. Production would not be reduced and there would be little impact on foreign trade. However, if assumptions regarding existing status of treatment, projected pollution control costs, and industry costs and returns are less favorable than those used in the analysis, the impact on the industry could be much more severe and would result in closure of a large percentage of plants not served by municipal treatment systems.

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ECONOMIC ANALYSIS OF EFFLUENT GUIDELINES:

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February, 1974

Prepared for
Office of Planning and Evaluation
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Washington, D. C. 20460

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PREFACE

The attached document is a contractor's study prepared with the supervision and review of the Office of Planning and Evaluation of the U. S. Environmental Protection Agency (EPA). Its purpose is to provide a basis for evaluating the potential economic impact of effluent limitations guidelines and standards of performance established by EPA pursuant to sections 304(b) and 306 of the Federal Water Pollution Control Act.

The study supplements an EPA technical "Development Document" issued in conjunction with the promulgation of guidelines and standards for point sources within this industry category. The Development Document surveys existing and potential waste treatment and control methods and technologies within this category and presents the investment and operating costs associated with various control technologies. This study supplements that analysis by estimating the broader economic effects (including product price increases, continued viability of affected plants, employment, industry growth and foreign trade) of the required application of certain of these control technologies.

This study has been submitted in fulfillment of Contract No. 68-01-1533, Task No. 19 by Development Planning and Research Associates, Inc. Work was completed as of May, 1974. The study is based primarily upon an earlier study, also prepared by Development Planning and Research Associates, Inc. entitled "Economic Analysis of Proposed Effluent Guidelines for the Meat Packing Industry." The earlier report was circulated in conjunction with the publication of the Federal Register of a notice of proposed rulemaking under sections 304(b) and 306 for the subject point source category. The analysis contained in the original study has been updated based upon information received during the period of time between publication of the notice of proposed rulemaking and the promulgation of the final regulation. Because of the constratints of time, the control and treatment costs analyzed in this study may not in all instances be identical to those associated with the requirements of the promulgated regulation. However, those differences, when they exist, are minor insofar as the final conclusions of the study are concerned.

This report represents the conclusions of the contractor. It has been reviewed by the Office of Planning and Evaluation and approved for publication. Approval does not signify that the contents necessarily reflect the views of the Environmental Protection Agency. The study has been considered, together with the Development Document, information received in the form of public comments on the proposed regulation, and other materials in the establishment of final effluent limitations guidelines and standards of performance.

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INDUSTRY SUMMARY

EXECUTIVE SUMMARY

This report seeks to determine the economic impact on the meat packing and slaughtering industry of the Environmental Protection Agency's effluent guidelines for this industry.

INDUSTRY SEGMENTS

The analysis considers meat packing plants and slaughter houses (SIC 2011) and includes the following types of plants and activities:

1.	Meat packinghouses:	livestock slaughtering and meat and meat product processing
2.	Slaughterhouses:	livestock slaughtering only

Firm and plant variations within the industry are diverse enough that effluent control requirements will significantly differ in their impact upon individual plants.

Types of Firms and Plants

Single-plant vs Multiple-plant Firms

The meat packing and slaughtering industry is characterized by a preponderance of single-plant firms. Information on ownership of federally-inspected plants, which account for 90 percent of the total commercial slaughter, indicates that 97 percent of the firms in the industry are single plant firms; however, multiple-plant firms are generally larger than single-plant firms. In recent years, many of the major meat packers have been acquired by conglomerates. The industry is characterized by a high dollar value of sales, in total and per employee.

Concentration

Concentration in the meat packing industry is declining. The percentage of total value of shipments accounted for by the four largest packers dropped from 41 percent to 26 percent from 1947 to 1967. There is still, however, a high degree of concentration in the industry. The 20 largest companies (out of a total of 2,529 firms) produced 50 percent of the total value of shipments in 1967.

Integration

Horizontal integration is frequent with multiple-plant firms horizontally extending their operations through establishing new plants doing essentially the same slaughter and processing functions. Vertical integration exists, forward into the wholesaling function--a traditional part of the meat packing industry, and backward toward packer feeding of cattle--usually in custom feedlots. Packer feeding varies between 4 and 8 percent of the total marketings of feeder cattle.

Size of Plants

This study classified meat packers and slaughterers into three size groups: large (200 million pounds or greater annual liveweight killed), medium (25 million to 200 million pounds), and small (300 thousand pounds to 25 million pounds). According to a special tabulation made by the Statistical Reporting Service, USDA, for this project, there were, in 1971, 84 large plants, 309 medium plants and an estimated 3,600 small plants.

Number and Location of Plants

In total (including locker plants, custom butchers and other very small slaughterers), there were 5,991 slaughtering plants in the United States as of March 1, 1973 located for the most part in Texas (561), Pennsylvania (492), Iowa (365), Ohio (316), Minnesota (275), Missouri (275), Illinois (249), Wisconsin (228), Nebraska (205) and Kansas (204). In terms of volume of slaughter, Iowa dominates the industry with 1972 volume of over 10 billion pounds liveweight killed. Nebraska is second (5.7 billion pounds), Texas kills 3.9 billion pounds, California, Kansas, Illinois, Colorado and Minnesota follow in order with annual kills of 3.0 to 3.4 billion pounds and Wisconsin and Ohio kill about 2.0 billion annually. Substantial numbers of plants are found in every state.

To limit the analysis to "commercial" plants, this study includes only those slaughtering more than two million pounds live weight annually. This volume is equivalent to an average slaughter of seven 1,040-pound steers per day.

These plants were used as the baseline case and numbers are shown in the following table:

Table S-1. Estimated number of meat packing and slaughter plants, by size and type, employing baseline effluent treatment levels, 1973, 1977, and 1983

Type and Size of Plant	Number of Plants		
	1973	1977	1983
Meat packinghouses			
Large and extra large	85	135	195
Medium	305	307	310
Small	750	695	640
Slaughterhouses			
Large and extra large	22	30	35
Medium	80	68	55
Small	178	144	110
Total number of plants with over 2 million lbs. LWK/Yr.	1,420	1,379	1,345

Employment

Employment in the meat packing and slaughtering industry has declined during the past decade as new, more highly automated plants have increased labor productivity. Total employment had dropped from 220 thousand in 1954 to 158 thousand in 1972. During this same period, payrolls as a percent of values added have decreased from 68 percent to 52 percent and value added per man hour of production has increased from $3.93 to $11.64.

Wages in the industry are relatively high, averaging 17 percent above the average for all manufacturing industries. Plants with collective bargaining agreements employ over 80 percent of the workers in the industry.

FINANCIAL PROFILE

Earnings

The meat packing and slaughtering industry is characterized by high dollar sales volume and low sales dollar earnings.

Over the period 1959 through 1972, the industry earned approximately one percent on sales, after tax. The ratio of earnings-to-total assets averaged 5 percent and earnings-to-net-worth were 8.3 percent over the same period.

Distribution of Sales Dollar

The meat packing and slaughtering industry has high raw material costs (79 percent of total costs in 1972). Wages and salaries (8.5 percent) constitute about half of all other operating expenses (19.4 percent). The before-tax earnings in 1972 were 1.5 percent on sales; after tax earnings were 0.8 percent.

Cash Flows and Internal Rates of Return - Representative Plants

In order to provide a base from which to measure the impact of water pollution controls on the meat industry, it was necessary to define "representative" plants and to synthesize investments, operating costs, working capital requirements, revenues and cash flows for these plants. Given these data, fully-discounted internal rates of return were calculated with varying assumptions as to size and investment cost basis for each type of plant.

Models were developed for two basic types of plants:

1. Meat packinghouses - slaughter and process both cattle and hogs
2. Slaughter plants - slaughter only
    a. Cattle slaughter only
    b. Hog slaughter only
    c. Combined cattle and hog slaughter

Three sizes of plants were used:

Large	-	280 million pounds annual liveweight
Medium	-	140 million pounds annual liveweight
Small	-	23 million pounds annual liveweight

Cash flows and rates of return were calculated on the basis of two different investment assumptions for each plant:

1. Full replacement cost - land, buildings and equipment
2. Ten percent of replacement cost of buildings and equipment plus original value of the land - the salvage value of the investment.

All plants were assumed to operate at 85 percent of capacity.

Plant Categories

To conform to plant categories specified by EPA effluent guidelines, plants were further identified by the extent to which they processed by-products.

Simple slaughterhouse	-	slaughters, but does only limited by-product processing (no more than two secondary processes)
Complex slaughterhouse	-	slaughters and does extensive by-product processing (three or more secondary processes)
Low-processing packinghouse	-	Normally processes less than the total of animals killed
High-processing packinghouse	-	processes its total kill as well as carcasses purchased from other sources.

Operating characteristics, product mix, annual through-put, gross margins, operating expenses, cash earnings, depreciation and interest and pre-tax incomes were calculated for each size and type of plant as were return on average invested capital (before and after tax) and after-tax return on sales. The resulting incomes and returns are shown in Table S-2.

Table S-2. Pre-tax net income and rate of return on average invested capital and after tax return on sales for meat packing plants

Type and Size of Plan	Pre-tax Income ($000)	Pre-tax ROI* (%)	After tax ROI* (%)	After tax return on sales (%)
Simple Beef Slaughter				
Small	35	8.0	4.1	0.28
Medium	315	14.0	7.3	0.43
Complex Beef Slaughter				
Medium	322	14.1	7.3	0.44
Large	651	15.9	8.3	0.45
Simple Combined Slaughter				
Small	59	12.0	6.3	0.56
Medium	322	14.4	7.5	0.52
Complex Combined Slaughter				
Medium	330	14.5	7.5	0.52
Large	720	18.2	9.5	0.57
Meat Packing House				
Small	125	10.9	5.7	0.80
Medium	846	16.5	8.6	0.94
Large	1,998	21.7	11.3	1.11

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* Average return on fixed investment calculated by financial statement method.

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Constraints on Financing Additional Capital Assets

Constraints on financing additional capital required for water pollution control facilities will vary greatly from firm to firm and from location to location. However, the availability of capital is not always the primary determinant. Plant profitability, age, equipment, or location may dictate that pollution control costs make further plant investment unwise. Medium and large plants will have access to adequate capital sources, but capital availability will be a problem for many small plants.

PRICE EFFECTS

Pricing Processes

Price determination in the meat packing industry depends upon basic supply and demand conditions. Meat packers deal with large numbers of individual livestock producers, no one of whom can appreciably influence supplies or can operate independently of present and future market conditions and anticipated prices. On the demand side, meat packers sell to literally thousands of independent retail food outlets and supermarket chains and the demand for meat is still determined in the market place by the demands of millions of consumers.

Increased costs associated with the implementation of effluent guidelines must be (1) absorbed by meat packers, (2) passed forward to consumers as higher meat prices, (3) passed backward to suppliers as lower prices for slaughter livestock, or (4) a combination of (1), (2) and (3).

In recent years, consumer demand for meat, stimulated by rising consumer incomes, outpaced increases in livestock supplies and resulted in rapidly rising livestock and meat prices. Although livestock prices have declined from record levels in 1973, margins in the meat packing industry are still narrow, and presumably cost increases associated with effluent controls will be passed primarily as higher retail meat prices.

ECONOMIC IMPACT METHODOLOGY

Fundamental Methodology

The economic impact analysis utilizes the basic data developed on industry segments, financial profiles and price effects, together with pollution abatement technology and costs developed by EPA. Impacts analyzed include:

- Price effects
- Financial effects
- Production effects
- Employment effects
- Community effects
- Foreign trade effects

The determining force of plant shutdowns on these impacts is crucial; consequently, the financial and production effects which most immediately reflect plant shutdowns, were given most emphasis in this analysis.

In general, the approach used can be simply stated as the problem of deciding whether a commitment of time or money to a project is worthwhile in terms of the expected benefits. The primary factors involved in assessing the financial and production impact of pollution control are profitability changes and these, in turn, are a function of the cost of pollution control and the ability to pass along these costs as higher prices. In reality, of course, closure decisions are seldom made on the basis of well-defined economic rules. Such decisions invariably include a wide range of personal values, external forces such as the ability to obtain financing, or the role of the production unit in an integrated larger cost center.

However, the analysis was made on the premise that economic returns in the industry would be the primary determinants of plant closures. In the most fundamental case, a plant will close when variable expenses (Vc) are greater than revenues (R). A more probable situation is the case in which $Vc < R$, but revenues are less than variable costs plus fixed, short-run cash overhead expenses (TC_c). In this situation a plant would likely continue to operate in the short-run but would be forced out over a longer period of time. Necessary to such a situation is the firm's expectation that revenues will increase to cover total cash outlay. Identification of plants where $TCc > R$ but $Vc < R$ leads to an estimate of plants that should eventually close if revenues do not increase.

The next level of analysis, where $TCc < R$, involves estimating the earnings before and after investment is pollution abatement. Under conditions in which $TCc < R$, it seems likely that investment in pollution control will be made and that plant operations will continue so long as the capitalized value of earnings (CV) is greater than the salvage value of the sunk investment of the plant. Computation of CV involves discounting the future earnings flow to the present worth. Discounted internal rates of return (the computed discount rate, or yield, which produces a zero present value of the cash flow) was the measure of profitability used. These rates of return, with and without pollution controls and the estimated salvage values of plant, equipment and land were the major factors used to determine potential plant shutdowns.

Price Effects

In order to provide a standard to reflect price effects, an estimated price adjustment sufficient to offset required pollution control costs was calculated. Application of the discounted cash flow procedure to pollution control costs yields present values and from this the price increase required to pay for pollution control was calculated by the formula:

$$X = \frac{PVP\ (100)}{(1-T)\ (PVR)}$$

where: X = required percentage increase in price
PVP = present value of pollution control costs
PVR = present value of gross revenue starting in the year pollution control is imposed

Production Effects

A study of the technological characteristics of the industry and of industry production practices underlay the analysis of probable changes in plant capacity utilization and in the industry's ability to absorb capacity losses as marginally productive plants are closed.

Employment Effects

Given the production effects of estimated production curtailments, of plant closings, and of changes in industry growth, employment effects were estimated on the basis of known production-employment relationships.

EFFLUENT CONTROL COSTS

Water pollution control costs used in this analysis were furnished by the Effluent Guidelines Division of the Environmental Protection Agency [1] and were adapted to the types and sizes of slaughter plants and packinghouses specified in this analysis.

Three effluent guideline requirements were considered:

BPT - Best Pollution Control Technology Currently Available (to be achieved by July 1, 1977)

BAT - Best Available Pollution Control Technology Economically Achievable (to be achieved by July 1, 1983)

NSPS - New Source Performance Standards, apply to any source for which construction starts after the publication of the proposed regulations for the Standards

A technical document entitled "Meat Products Point Source Category - Proposed Effluent Limitation Guidelines for Existing Sources and Standards for New Sources" describing the recommended technology for achieving the three guidelines has been published by EPA in the Federal Register (October 29, 1973). To avoid duplication and possible confusion, no technical descriptions of BPT, BAT and NSPS guidelines are given in the present report. The interested reader is referred to EPA's technical document for technology descriptions.

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[1] Development Document for Proposed Effluent Limitations Guidelines and New Source Performance Standards for the Red Meat Processing Segment of the Meat Products Point Source Category," Environmental Protection Agency, June, 1973.

Modified Costs - Effluent Control Systems

The effluent control costs provided by EPA were "single point" estimates which applied specifically to a given type of plant with a given annual live-weight kill volume. Obviously, effluent treatment costs vary with waste-flow and, hence, processing volume. Based on discussions with EPA and North Star Research Institute personnel, DPRA estimated investment and annual treatment cost data for alternative plant sizes.

Baseline Effluent Control Costs

Effluent control costs for each of the three treatment levels were based upon an assumption that baseline pre-BPT treatment included an in-place system for the removal of settleable solids and grease and a second system employing anaerobic and aerobic lagoons.

Incremental Effluent Control Costs

Given the baseline effluent control costs which were assumed to be in place for the "typical" plants specified, estimates were given for the incremental costs required to achieve effluent controls adequate to meet BPT and BAT guidelines for the four "typical" plants. Costs for meeting NSPS guidelines were assumed to equal BPT costs until 1983 at which time they will actually equal BAT costs.

Having developed baseline and incremental treatment costs for BPT and BAT controls, these costs were added to get "total" control costs.

Since the cost data provided to DPRA were based on 1971 costs, they were updated to 1972 levels by using appropriate inflators (i.e., Index of Sewage Treatment Plant Construction Cost for investment; and the Implicit Price Inflator for GNP for operating costs).

Current Status of Effluent Control

Limited information was available concerning the current status of effluent treatment and control in the meat industry.

The best information available was based on surveys conducted by North Star Research Institute for the Environmental Protection Agency. These estimates indicate that 56 percent of the simple slaughterhouses, 29 percent of the complex slaughterhouses, 70 percent of the low-process meat packinghouses and 59 percent of the high-process packinghouses discharge into municipal sewers. Virtually all plants have primary treatment systems to remove settleable solids and most grease, and about 80 percent of the flow of slaughterhouses and 40 percent of the flow of packinghouses are treated by anaerobic and aerobic lagoons. The impact analysis assumed, on the basis of surveys and consultants' estimates, that all direct dischargers have baseline treatment systems in place.

IMPACT ANALYSIS

The imposition of effluent controls on the livestock slaughtering and meat packing industry will have both direct and indirect impacts on the industry and its suppliers, on consumers, and on communities in which meat plants are located.

Price Effects

The role of price effects in this analysis is critical. If it is possible to achieve a minor increase in packer margins, the additional costs of effluent controls can be partially or, perhaps, totally offset. We expect this to be the case in the long run under BPT guidelines; however, the situation under BAT guidelines is less encouraging.

The incremental costs under BPT guidelines are very small compared to sales volume--less than 0.2 percent. The average wholesale price increase required to offset BPT guidelines in medium and large plants, not discharging into municipal sewers, would average about 0.05 percent. For small plants the increase to meet BPT requirements would be in the range of .13 to .15 percent. These changes are small and would, under present circumstances, probably be passed on to the consumer.

Price increases required to meet BAT guidelines would equal approximately 0.30 - 0.40 percent for large plants, 0.40 to 0.70 for medium plants and 1.10 to 1.25 percent for small plants. Given the magnitude of price changes required to meet BAT standards for plants not discharging into municipal sewers, these plants would be at a decided disadvantage compared to plants so discharging. In general, the competitive position of sewered plants would be sufficient to hold margins at BPT levels. Those firms requiring private treatment systems would be forced to close or to absorb the added cost of BAT preatment.

Financial Effects

The impact of alternative effluent treatment levels on pre-tax net income of specified types and sizes of model livestock slaughter plants and meat packinghouses is shown below. In general, the imposition of BPT controls results in a moderate income reduction, and BAT controls impact severely on incomes.

Slaughter plant income is more reduced than is that of packinghouses, and small plants show greater relative reductions in income than do larger plants. The relative income impacts are as follows:

Type and size of plant	Percent reduction from "baseline" income	
	BPT (%)	BAT (%)
Simple beef slaughter		
Small	26	183
Medium	5	46
Complex beef slaughter		
Medium	9	73
Large	6	45
Simple beef-hog slaughter		
Small	15	120
Medium	7	54
Complex beef-hog slaughter		
Medium	9	71
Large	6	41
Low-process packinghouse		
Small	10	72
Medium	4	24
Large	2	15

Production Effects

BPT guideline requirements are not expected to significantly affect red meat production volume. The impact of BAT water pollution control requirements on the production of meat and processed meat products will be felt principally in the closing of small plants whose volume of production is such that the incremental costs required to install additional water pollution control systems make the continued operation of these plants uneconomic. However, such plants account for a small part of total industry production.

Plant Closures

Plant closures in the meat packing and slaughter industry would be greatest among small plants and would affect slaughter-only plants more than meat packinghouses.

The imposition of BPT requirements (1977), assuming that existing plants have baseline treatment systems in effect, would result in only one small slaughter plant closure. Although BPT control costs are appreciable and would reduce profits, they are not generally great enough to result in plant shutdowns.

BAT control requirements (1983) would result in the closure of 45 small slaughter plants, 4 medium and 1 large slaughter plants and 16 small and 1 medium packinghouse.

Most very small slaughterers (locker plants and custom butchers) kill as a service related to their primary business. Their volume of effluent is low and many dispose of it through sewers. Those that do not could probably dispose of their effluent, after minor in-plant procedure changes, through ordinary septic tanks.

Employment Effects

Unemployment would be directly related to plant closures. Opportunities for reemployment in existing plants or new plants would be few. BPT-associated closures would have only a minor employment impact--a loss of 25 jobs and $130,000 in payrolls. However, BAT-associated closures would result in the loss of 2,765 jobs and an annual payroll reduction of $21.9 million.

Community Effects

A high proportion of meat packinghouses and slaughterhouses are located in small communities--60 percent of all federally-inspected plants are located in cities of less than 25,000 population. The loss of a small plant would reduce payrolls in a city of 25,000 by $400,000 or approximately 0.65 percent. For a city of 8,000, the loss of a small plant could reduce total payrolls by 5 percent. Other impacts would be felt in the loss of taxes and in general trade generated by the payrolls of the plant.

In many localities, especially in recent years, meat plants have been financed through municipal revenue bonds, and in such instances, the closing of a plant would result in added burdens for the city budget.

Balance of Payment Effects

The United States, not a major exporter of meats, imports increasingly large amounts of meat, mainly beef. Since pollution associated meat plant closures would not be expected to have an appreciable effect on the volume of slaughter in the United States, such closures would have a negligible effect on imports and exports of meat and the balance of payments associated with the meat industry.

LIMITS OF THE ANALYSIS

Although detailed data on size distribution by types of plants is not available, it is clear that the livestock slaughtering and meat packing industry is complex in terms of the number, ownership and geographic distribution of firms as well as in its sizes and types of plants.

Financial information concerned with investments, operating costs and returns was not available for individual plants or firms. As a result, the financial aspects of the impact analysis were, of necessity, based on synthesized costs and returns for "representative" types and sizes of model plants. These costs and returns were developed from a variety of sources including published research from universities and government agencies, previous studies done by the contractor, information obtained from operating firms in the meat industry, published financial performance data, and discussions with meat processing consultants, meat plant architects and other knowledgeable individuals.

Published information from the Internal Revenue Service, such references as Standard and Poors, Dun and Bradstreet, and other sources of data on financial ratios and financial performance were used as checks on the reasonableness of results obtained in the financial analysis of representative plants.

Throughout the study, an effort was made to evaluate the data and other information used and to update these materials wherever possible. Checks were made with informed sources in both industry and government to help insure that the data and other information used were as reliable and as representative as possible. For example, construction costs were checked with established meat plant architects, working capital requirements were checked with the comptroller of a major meat packing firm, rendering equipment costs were based on a firm quote from an equipment supplier for a plant similar to one used in the analysis. The construction of published product prices was checked with the Market News Service, U.S.D.A., which constructs and publishes these price series. Efforts were made to use the latest available data.

Water pollution control costs were furnished by EPA, Effluent Guidelines Division and resulted from costs developed for EPA by North Star Research Institute. These costs were developed for four "typical" meat processing plants as described earlier in this report. It was necessary to adapt these costs to the types and sizes of model plants used in this analysis. This adaption process required the making of assumptions and adjustments related to these data which are critical to the impact analysis. In addition, it was necessary to make specific assumptions regarding the current status of effluent disposal and treatment in the meat packing industry. These assumptions are described in detail in the "Critical Assumptions" section of this report. The validity of these assumptions and of the effluent control costs which result introduce an additional element of uncertainty and possible inaccuracy.

However, assuming the accuracy of the pollution control costs, it is believed that the analysis represents a usefully accurate evaluation of the economic impact of the proposed effluent guidelines on the livestock slaughtering and meat packing industry.

ECONOMIC ANALYSIS OF EFFLUENT GUIDELINES:

MEAT PACKING INDUSTRY

I. INDUSTRY SEGMENTS

In an earlier study, "Initial Analysis of the Economic Impact of Water Pollution Control Costs Upon the Meat Industry," completed in November, 1972 for the Environmental Protection Agency by Development Planning and Research Associates, Inc., preliminary estimates were made of the impact of water pollution controls proposed at that time.

The purpose of the present report is to determine the economic impact on the meat packing and slaughtering industry of the Environmental Protection Agency's effluent guidelines and to update, expand and improve upon the earlier analysis.

This analysis considers meat packing plants and slaughter houses (SIC 2011) and includes the following types of plants and activities:

1. Meat packinghouses: livestock slaughtering and meat and meat product processing
2. Slaughterhouses: livestock slaughtering only.

The analysis is limited to beef and pork operations. The slaughter of calves (1.5%) and sheep and lambs (1.8%) constitutes but a small part of the total volume of livestock slaughtered, and since adequate data on slaughter costs for these species are unavailable, those operations have not been considered of the analysis.

Firm and plant variations within the industry are diverse enough that the effluent control requirements will significantly differ in their impact upon individual plants. Such variations include the following:

* Types of firms and plants
* Size of firms and plants
* Level and direction of integration
* Degree of specialization
* Number and location of plants
* Level of technology and efficiency of plants
* Employment
* Concentration of ownership of plants and of production

Types of Firms and Plants

Multiple vs. Single-Plant Firms

The meat packing and slaughtering industry is characterized by a preponderance of single-plant firms. The number of firms and number of plants (SIC 2011) as reported by the Census of Manufactures, 1947-1972 was as follows:

Year	Number of Firms	Number of Plants	Ave. Plants per Firm
1947	1,999	2,154	1.08
1954	2,228	2,367	1.06
1958	2,646	2,810	1.06
1963	2,833	2,992	1.06
1967	2,529	2,697	1.06
1972	--	2,443 [1]	

The relationship between the number of firms and the number of plants has been relatively constant over the past 15 years.

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[1] Preliminary

Information on ownership of federally-inspected meat packing plants, which account for 90 percent of total commercial slaughter indicates the following distribution among single-plant and multiple-plant firms in November, 1973:

Type of Firm	No. Firms	% of Total	No. Plants	% of Total
Single plant	1,193	97.2	1,193	89.2
2 plants	19	1.5	38	2.8
3 plants	6	.5	18	1.4
4 - 9 plants	6	.5	37	2.8
10 or more plants	3	.3	51	3.8
Total	1,227	100.0	1,337	100.0

These data refer only to those meat packinghouses and slaughter plants which kill livestock and exclude specialized processing plants, which do no killing.

Size of Firms

Since 97 percent of the firms represented by the Federally-inspected plants and virtually all of the state-inspected firms are single plant firms, the size distribution of firms is closely related to size distribution of plants. Multiple-plant firms are generally, but no always, larger than single plant firms. In recent years, many major meat packers have been acquired by conglomerates (e.g. Armour by Greyhound, Wilson by LTV Corp., and Morrell by AMK Corporation) and some have become conglomerates themselves through acquisition and diversification (e.g. Swift and Company, now ESMARK). The Packers Consent Decree (1920) limits the extent to which meat packers own closely related businesses.

The industry is characterized by high dollar value of sales per firm. For instance, the Fortune list by sales of all firm products of the 500 largest United States corporations includes thirteen meat packing companies. In the listing of "sales per employee" category, five of the highest ranking ten firms were meat packers, and only the fact that several packers are firms within conglomerate prevented a higher ratio. Similarly, for "sales per dollar of stockholder's equity" six of the ten leading firms were independent meat packers.

Concentration of Ownership

When value of shipments is analyzed by company ownership, industry concentration becomes apparent. Out of the 2,697 plants reported by the 1967 Census, 350, or 13 percent, were owned by multi-unit companies. Importantly, these accounted for a high percentage of the total value of shipments by the industry.

Table I-1. Meat packing industry concentration: percent of shipments accounted for by largest companies, 1947-1967 1/

		Value of Shipments				
		Total	Percent accounted for by			
Year	No. Companies	(million) Dollars	4 largest companies	8 largest companies	20 largest companies	50 large companie
1967	2,529	2,220.5	26	38	50	62
1963	2,833	1,908.3	31	42	54	64
1958	2,646	1,677.1	34	46	57	65
1954	2,228	1,394.5	39	51	60	NA
1947	1,999	977.1	41	54	63	NA

1/ Source: U.S. Department of Commerce, Census of Manufactures, 1967.

The total shipment percentage of the four leading packers dropped from 41% to 26% from 1947 to 1967, a drop of 15%. The eight largest packers' percentage decreased 18 percent; the 20 largest, 13 percent. This indicates that most of the loss occurred in the "big 4" and that certain firms in the 20 largest group gained rather than lost during the period. There is still, however, a high degree of concentration in the meat packing industry. The 20 largest companies (out of a total of 2,529 firms) produced 50 percent of the total value of shipments in 1967, the latest date for which data are available.

Level of Integration

Horizontal integration is frequent in the industry. Although most firms are single-plant firms, multiple-plant firms have horizontally extended their operations by establishing new plants doing essentially the same killing and processing functions. In some instances, new plants specialize in slaughter and/or processing operations. The plants normally operate as separate cost centers within the overall corporate organization.

Vertical integration is structured either toward the consumer or the suppliers. Despite the existence of independent wholesalers and jobbers, meat packers have traditionally integrated through wholesaling functions. Prior to 1920, packers were increasingly involved in operating a variety of related businesses; however, in 1918 such aspirations by the "big" packers were criticized by the newly created Federal Trade Commission and in February 1920, the five major companies signed the famous "Packers Consent Decree." The companies agreed to divest themselves of holdings in stockyards, terminal railroads, cold-storage warehouses, and market newspapers. They agreed, also, to refrain from handling a long list of non-meat products, including fresh milk or cream and to operate no retail meat markets in the United States. The "Consent Decree" thus limited the ability of packers to integrate toward retail meat sales or to acquire and operate businesses closely related to their industry.

Packers have used production-oriented vertical integration by feeding their own slaughter cattle, usually in commercial custom feedlots in order to increase slaughtering operation efficiency by providing a dependable daily and seasonal supply of cattle. Independent cattle feeders are apprehensive over the development of vertical-integrated production. Recognizing its effect on the broiler industry, they fear packers may use such cattle feeder control as a price hedge, or tc depress prices as they negotiate for additional animals in the market. However, packer feeding tends to vary with market conditions, and since 1954 has ranged between 4 and 8 percent of total fed marketings of cattle. When feeding by "associated interests," including separate feeding by owners, directors, officers, employees, non-reporting subsidiaries and affiliates of packers is included, "packer fed" cattle may account for 8 to 12 percent of total fed cattle marketings. A study "Packer Feeding of Cattle" published by the Packers and Stockyards Division, Consumer and Marketing Service, U. S. Department of Agriculture, in 1966, concluded that although feeding of cattle by packers and associated interests could have a significant depressive effect on prices on specific markets, such feeding would not significantly affect the overall level of prices in a competitive market situation.

Size of Plants

This study classified meat packers and specialized slaughter plants into three size groups: large (200 million pounds or greater annual liveweight killed), medium (25 million to 200 million pounds), and small (300 thousand pounds to 25 million pounds).

A special tabulation of federally-inspected plants, by size category, was prepared for this study by the Statistical Reporting Service, U. S. Department of Agriculture. This distribution by plant size by state is shown in Table I-2. In order to conceal individual plant identify, plant classifications were combined in 18 states. However, the totals, by size group, for the United States, are correct as of August, 1971. Plant distribution, by size, for the U.S. in August, 1971 was as follows:

Size	Federally-Inspected	Non-Federally Inspected	Total
Large	84	-	84
Medium	309	-	309
Small	437	3,163	3,600
Total	830	3,163	3,993

Large plants are concentrated in Iowa (21), Nebraska (10), Kansas (5), Colorado (5), Minnesota (5), Illinois (4), Wisconsin (4), Missouri (4), Indiana (3) and Texas (3), and these 10 states accounted for 64 of the 84 largest plants. States having large numbers of small plants, most of which are state-inspected, include Minnesota (280), Pennsylvania (234), Ohio (212), Illinois (194), Texas (192), Iowa (182), Indiana (175), Michigan (172), Kansas (133), Wisconsin (110), and New York (103).

A substantial percentage of these small plants are frozen food lockers which kill and process livestock for their customers.

Table I-2. Federally-inspected meat plants distribution by size, by state, Aug., 1971

State	Number of Plants			
	Federally-inspected 1971			State-inspected 1970
	Large 1/	Medium 2/	Small 3/	Small
New England 4/	-	4	10	43
N. Y.	-	8	26	77
N. J.		6 5/	6	16
Pa.		11 5/	14	220
Ohio		16 5/	23	189
Ind.	3	5	8	167
Ill.	4	17	15	179
Mich.		9 5/	6	166
Wisc.	4	9	5	105
Minn.	5	8	25	255
Iowa	21	18	8	174
Mo.	4	5	13	54
N. Dak.	-		29 5/	49
S. Dak.		8 5/6/		33
Nebr.	10	21	14	57
Kans.	5	12	13	120
Del.-Md.-D.C.	-		8 5/	46
Va.		7 5/	12	21
W. Va.	-	-	7/	43
N. C.	-	4	9	78
S. C.	-		5 5/	55
Ga.	-	8 6/		87
Fla.	-	8 6/		40
Ky.		4 5/	18	40
Tenn.	-	8 5/	7	57
Ala.	-		5 5/	58
Miss.		5 5/	-	48
Ark.	-	4	4	49
La.	-	3	4	89
Okla.		4 5/	7	64
Tex.	3	37	36	156
Mont.	-		27 5/	30
Idaho	-	4	4	48
Wyo.	-	-	7/	11
Colo.	5	8	10	38
N. Mex.	-	4	9	8
Ariz.			7/	16
Utah	-	3	7	39
Nev.	-	-	7/	5
Wash.	-	8	14	28
Ore.	-	5	7	66
Calif.		40 5/	27	19
Haw.	-	7/	-	19
All Other	20	17	18	-
Total	84	309	437	3,163

1/ Over 200 million lbs. annual liveweight kill.

2/ 25 Million lbs. through 199 million lbs. annual liveweight kill.

3/ Less than 25 million lbs. but over 300 thousand pounds annual liveweight kill.

4/ New England includes Me., N.H., Vt., Mass., R.I., Conn.

Notations: dash (-) indicates none

5/ Plants from larger size group included to avoid disclosing individual operations.

6/ Plants from smaller size group included to avoid disclosing individual operations.

7/ Arizona, Hawaii, Nev., W. Virginia and Wyo. combined to avoid disclosing individual operations.

Reconciliation - SIC 2011 Meat Packing Plant Numbers with US Department of Agriculture Slaughter Plant Numbers

SIC 2011, the meat packing plant industry includes establishments primarily engaged in slaughtering, for their own account or on a contract basis.

SIC 2013, the sausages and other prepared meats industry, includes establishments primarily engaged in manufacturing sausages, cured meats, smoked meats, canned meats, frozen meats, natural sausage casings, and other prepared meats and meat specialties from purchased carcasses and other materials.

In addition, some slaughtering operations are conducted in establishments not included in SIC 2011 in the Census of Manufactures. Certain SIC 2013 firms will slaughter as well as purchase meats for sausage manufacture, certain other establishments such as locker plants (SIC 4223) custom butchers, wholesale or retail/meat dealers also conduct slaughtering operations. The Census of Manufactures is believed to include about 90 percent of the total volume of commercial livestock slaughter.

The U. S. Department of Agriculture, through the Animal and Plant Health Inspection Service and the Statistical Reporting Service, maintains data series and publishes information on the number of slaughter plants and total volume of slaughter by species and by state. Data on federally-inspected meat plants come from the Animal and Plant Health Inspection Service and data on state-inspected plants come from equivalent state agencies. As opposed to the Census, no distinction is made regarding the type of slaughter establishment.

Since only limited data were available for the 1972 Census of Manufactures and since the 1967 Census data do not reflect the substantial changes which have occurred in the meat packing and slaughter industry, it was necessary to use USDA data on the number of slaughter plants to define the industry. Estimates were made of the number of very small plants (under two million pounds annual kill) and these were not considered in the impact analysis. It is estimated that plants included account for at least 90 percent of the total volume of slaughter in the United States.

Number and Location of Meatpacking Plants

The number of meat packing and slaughter plants and the characteristics of the composite of plants which represent the industry change constantly. Various agencies of the U. S. Department of Agriculture periodically estimate plant numbers and analyze industry plant characteristics. Certain estimates, e.g., number of slaughter plants by species slaughtered, are made only every five years. Other data, e.g., number of livestock slaughtering establishments, are published on March 1 of each year. In addition, certain special tabulations are occasionally made (e.g., distribution of plants by size, August, 1971). As a result, since data regarding all characteristics of the industry are not available for a single point in time, it is impossible to realize an accurate and total profile of the industry at any given point in time. Although direct comparisons of plant numbers and plant characteristics are, therefore, difficult, the data are consistent and reflect constant changes.

There were 5,991 livestock slaughtering plants in the United States on March 1, 1973, down from 6,156 in 1972 and 6,400 in 1971 (Table I-3). In contrast to this steady decline, there has been a rapid increase in the number of Federally inspected plants -- 766 in 1971, 1,364 in March, 1973, as inspection requirements have been more vigorously enforced. The increase in Federally inspected plants and the decrease in total number of plants reflects the fact that increasingly vigorous enforcement has effected the closure of many plants.

In terms of the total number of slaughtering plants, the 10 leading states on March 1, 1973 were as follows:

Rank	State	No. Plants
1	Texas	561
2	Pennsylvania	492
3	Iowa	365
4	Ohio	316
5	Minnesota	275
6	Missouri	275
7	Illinois	249
8	Wisconsin	228
9	Nebraska	205
10	Kansas	204

Table I-3. NUMBER OF LIVESTOCK SLAUGHTERING ESTABLISHMENTS, MARCH 1, 1971, 1972 and 1973

State	Under Federal Inspection			Other			Total		
	1971	1972	1973	1971	1972	1973	1971	1972	1973
New England	14	17	20	130	83	94	144	100	114
New York	33	35	32	110	98	90	143	133	122
New Jersey	12	12	11	37	36	36	49	48	47
Pennsylvania	25	26	336	391	387	156	416	413	492
Ohio	39	40	36	265	294	280	304	334	316
Indiana	14	15	15	202	190	165	216	205	180
Illinois	34	38	34	235*	215	215	269	253	249
Michigan	13	16	17	174	171	164	187	187	181
Wisconsin	18	19	18	217	218	210	235	237	228
Minnesota	16	67	48	323	249	227	339	316	275
Iowa	45	48	45	353	340	320	398	388	365
Missouri	23	25	125	350	282	150	373	307	275
North Dakota	43	40	37	64*	62	53	107*	102	90
South Dakota	8	8	7	113	113	90	121	121	97
Nebraska	34	102	80	188	105	125	222	207	205
Kansas	25	31	27	186	176	177	211	207	204
Delaware - Maryland	8	10	9	72	70	54	80	80	63
Virginia	20	22	21	66	78	70	86	100	91
West Virginia	1	1	2	74	69	61	75	70	63
North Carolina	13	14	12	98	96	106	111	110	118
South Carolina	4	5	5	58	56	54	62	61	59
Georgia	7	8	8	154	138	132	161	146	140
Florida	8	8	6	49	53	52	57	61	58
Kentucky	18	48	44	109	60	60	127	108	104
Tennessee	15	16	16	139	128	116	154	144	132
Alabama	6	6	7	72	91	100	78	97	107
Mississippi	5	7	8	116	105	84	121	112	92
Arkansas	9	9	7	64	62	60	73	71	67
Louisiana	5	7	7	224	205	174	229	212	181
Oklahoma	11	12	13	176	164	179	187	176	192
Texas	73	76	75	425	415	486	498	491	561
Montana	5	29	30	48	19	16	53	48	46
Idaho	8	8	8	47	48	49	55	56	57
Wyoming	1	1	1	24	28	25	25	29	26
Colorado	24	23	23	59	61	52	83	84	75
New Mexico	16	16	14	15	16	15	31	32	29
Arizona	5	5	5	27	26	27	32	31	32
Utah	9	10	10	40	38	36	49	48	46
Nevada	1	2	2	5	5	5	6	7	7
Washington	21	21	22	23	23	20	44*	44	42
Oregon	12	12	57	70	64	6	82	76	63
California	64	68	63	20	14	14	84	82	77
48 States	765	983	1,363	5,612	5,151	4,605	6,377	6,134	5,968
Hawaii	1	1	1	22	21	22	23	22	23
U. S.	766	984	1,364	5,634	5,172	4,627	6,400	6,156	5,991

* Revised.

ANNUAL LIVESTOCK SLAUGHTER, April 1973

Crop Reporting Board, SRS, USDA

Distribution of Federally-inspected slaughter plants as of March 1, 1973 among the ten leading states was:

Rank	State	No. F.I. Plants	% of Total Plants
1	Pennsylvania	336	68
2	Missouri	125	45
3	Nebraska	80	39
4	Texas	75	13
5	California	63	82
6	Oregon	57	90
7	Minnesota	48	17
8	Iowa	45	12
9	Kentucky	44	42
10	North Dakota	37	41
	Other states	454	13
	Total U. S.	1,364	23

Substantial differences in the proportion of Federally-inspected plants exist among states. Oregon has 90 percent Federally-inspected, California 82 percent, and Pennsylvania 68 percent; West Virginia has only three percent of its slaughter plants Federally-inspected and Louisiana and Wyoming have four percent each.

Pounds of live weight killed is the best indicator of the total volume of meat packing in a given state. The ten leading states, for each species killed and for total kill, in 1972 are shown in Table I-4.

In terms of total slaughter, Iowa dominates the industry, ranking first in hog slaughter and second in cattle slaughter with a total annual kill in 1972 of over 10 billion pounds liveweight. Nebraska ranks second overall with an annual kill of 5.7 billion pounds of which 5.0 billion was represented by cattle slaughter alone. Texas kills 3.9 billion pounds--3.2 billion of cattle. California, Kansas, Illinois, Colorado and Minnesota follow in order with annual kills of 3.0 to 3.4 billion and Wisconsin and Ohio kill about 2.0 billion pounds annually. Calf slaughter is concentrated in the South and East, and the slaughter of sheep and lambs, in the West and Southwest.

Table I-4. Ranking states in meat packing, by species and total, 000 pounds liveweight killed, 1972.

Rank	Cattle		Hogs		Calves		Sheep & Lambs		Total Kill	
	State	Kill	State	Kill	State	Kill	State	Kill	State	Kill
		(000 lbs.)		(000 lbs.)		(000 lbs.)		(000 lbs.)		(000 lbs.)
1	Neb.	5,007,117	Iowa	5,066.360	La.	94,675	Colo.	211,553	Iowa	10,042.899
2	Iowa	4,898,258	Ill.	1.561.854	Texas	93.567	Calif.	186.825	Neb.	5,744,857
3	Texas	3,214,816	Minn.	1,244,831	N. Dak.	82,404	Texas	143,156	Texas	3,928,249
4	Calif.	2,830,246	Mich.	940,060	N. Y.	69,792	Neb.	96,299	Calif.	3,405,070
5	Kans.	2,657,005	Ohio	922,411	S. Car.	57,311	N. J.	64.517	Kans.	3,188,434
6	Colo.	2,642,532	Ind.	914,679	Calif.	46,211	Utah	56,207	Ill.	3,117,793
7	Minn.	1,635,620	Pa.	893,892	Wisc.	39,514	Iowa	48,443	Colo.	3,087,782
8	Ill.	1,492,812	Wisc.	778,267	Tenn.	35.609	Ill.	45,967	Minn.	2,906,349
9	Wisc.	1,242,415	Va.	719,170	Pa.	34,641	S. Dak.	44,647	Wisc.	2,060,542
10	Ohio	1,094,925	Tenn.	691,187	Iowa	29,838	Mich.	41,588	Ohio	2,033,246

Source: Livestock Slaughter, Annual Summary, 1972, SRS, USDA.

Geographic Distribution: Meat packing plants are found in every state. Two factors govern their location: (1) concentration of fed livestock for slaughter and (2) concentration of market demand. The trend in recent years has been away from major population centers toward areas having high densities of fed livestock. Figures I-1, 2 and 3 show the number and location of slaughter plants as of March 1, 1970.

Multiple vs. Single-species Plants

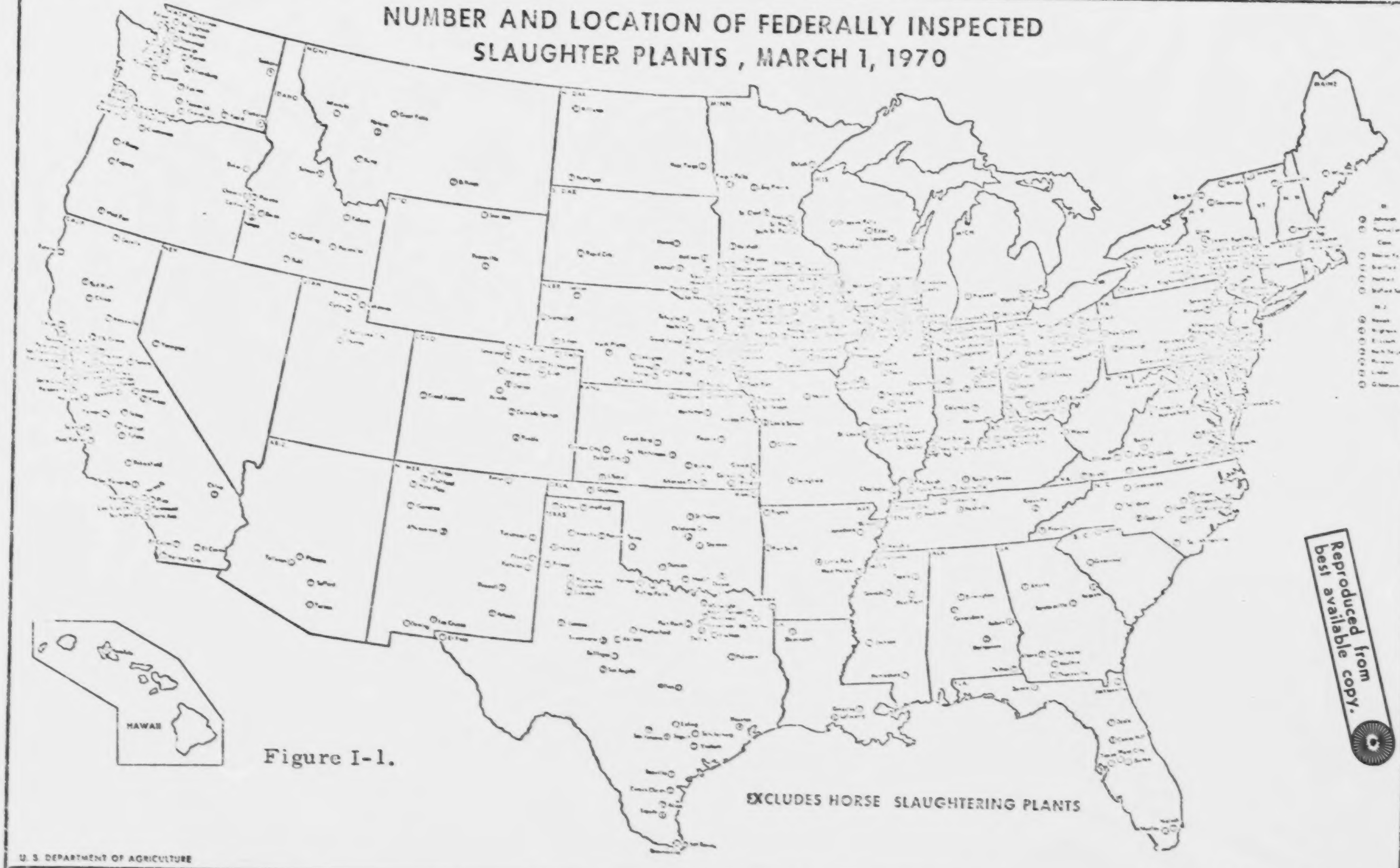
The number of plants slaughtering various combinations of livestock is shown by states in Table I-5. Most plants are multiple-species plants.

	March, 1970	
Species Killed	No. Plants	% of Total
Cattle, calves, hogs	1,557	40.0
Cattle, calves, hogs, sheep & lambs	1,477	38.0
Cattle and calves only	465	12.0
Cattle, calves, sheep & lambs	206	5.3
Hogs only	169	4.3
Sheep and lambs only	13	0.3
Hogs, sheep and lambs	2	0.1
Total	3,889	100.0

Table I-5. Number of livestock slaughter plants 1/ by species slaughtered, by States, March 1970

State 2/	Plants slaughtering: Cattle and calves, hogs and sheep and lambs	Cattle and calves only	Cattle and calves and hogs	Cattle and calves and sheep and lambs	Hogs only	Hogs and sheep and lambs	Sheep and lambs only	Total
	Number							
N. Eng.	29	7	3	14	3	--	--	56
N. Y.	67	16	6	20	4	--	--	113
N. J.	9	3	1	11	3	--	--	27
Pa.	50	56	98	31	11	--	--	246
Ohio	101	29	54	26	17	--	1	228
Ind.	9	17	142	8	5	--	--	181
Ill.	146	18	34	2	12	--	2	214
Mich.	107	24	15	19	11	--	--	176
Wis.	71	15	31	6	3	--	--	126
Minn.	99	12	158	1	2	--	--	272
Iowa	35	23	142	--	15	--	--	215
Mo.	34	11	23	2	6	--	--	76
N. Dak.	29	1	21	1	--	--	--	52
S. Dak.	27	4	9	--	2	--	--	42
Nebr.	31	28	30	1	--	--	1	91
Kans.	67	14	59	1	1	--	--	142
Del.-Md.	18	6	15	13	2	--	--	54
Va.	19	--	16	2	4	--	--	41
W. Va.	14	2	23	2	3	--	--	44
N. C.	13	5	60	--	11	--	--	89
S. C.	8	2	45	--	2	--	--	57
Ga.	5	3	78	--	7	--	--	93
Fla.	15	9	20	1	3	--	--	48
Ky.	12	5	29	1	4	--	2	53
Tenn.	26	2	33	2	9	--	--	72
Ala.	5	1	53	--	6	--	--	65
Miss.	--	4	49	--	1	--	--	54
Ark.	2	4	49	--	3	--	--	58
La.	23	14	54	--	1	--	--	92
Okla.	4	15	51	2	3	--	--	75
Texas	57	26	127	5	7	--	1	223
Mont.	25	2	6	3	--	--	--	36
Idaho	52	5	1	--	--	--	--	58
Wyo.	11	--	2	--	--	--	--	13
Colo.	37	12	5	4	3	--	--	61
N. Mex.	20	2	1	1	--	2	3	29
Ariz.	12	6	3	1	--	--	--	22
Utah	42	2	2	1	--	--	1	48
Nev.	5	1	--	--	--	--	--	6
Wash.	33	10	5	4	--	--	1	53
Oreg.	70	5	1	4	--	--	--	80
Calif.	[illegible]	24	1	16	1	--	1	88
48 States	[illegible]	455	1,555	205	[illegible]	2	13	[illegible]
Hawaii	3	10	2	1	4	--	--	20
U. S. Total	[illegible]	465	1,557	206	[illegible]	2	13	[illegible]

1/ Classified as to species slaughtered in 1969. Includes all Federally inspected plants plus all plants not under Federal inspection with an output of 300,000 pounds or more live weight annually.
2/ New England includes Maine, New Hampshire, Vermont, Massachusetts, Rhode Island and Connecticut. Commercial slaughter not estimated in Alaska.



NUMBER AND LOCATION OF FEDERALLY INSPECTED SLAUGHTER PLANTS, MARCH 1, 1970

EXCLUDES HORSE SLAUGHTERING PLANTS

U. S. DEPARTMENT OF AGRICULTURE

NEG. SRS 234-70(5) STATISTICAL REPORTING SERVICE

Figure I-1.

Reproduced from best available copy.

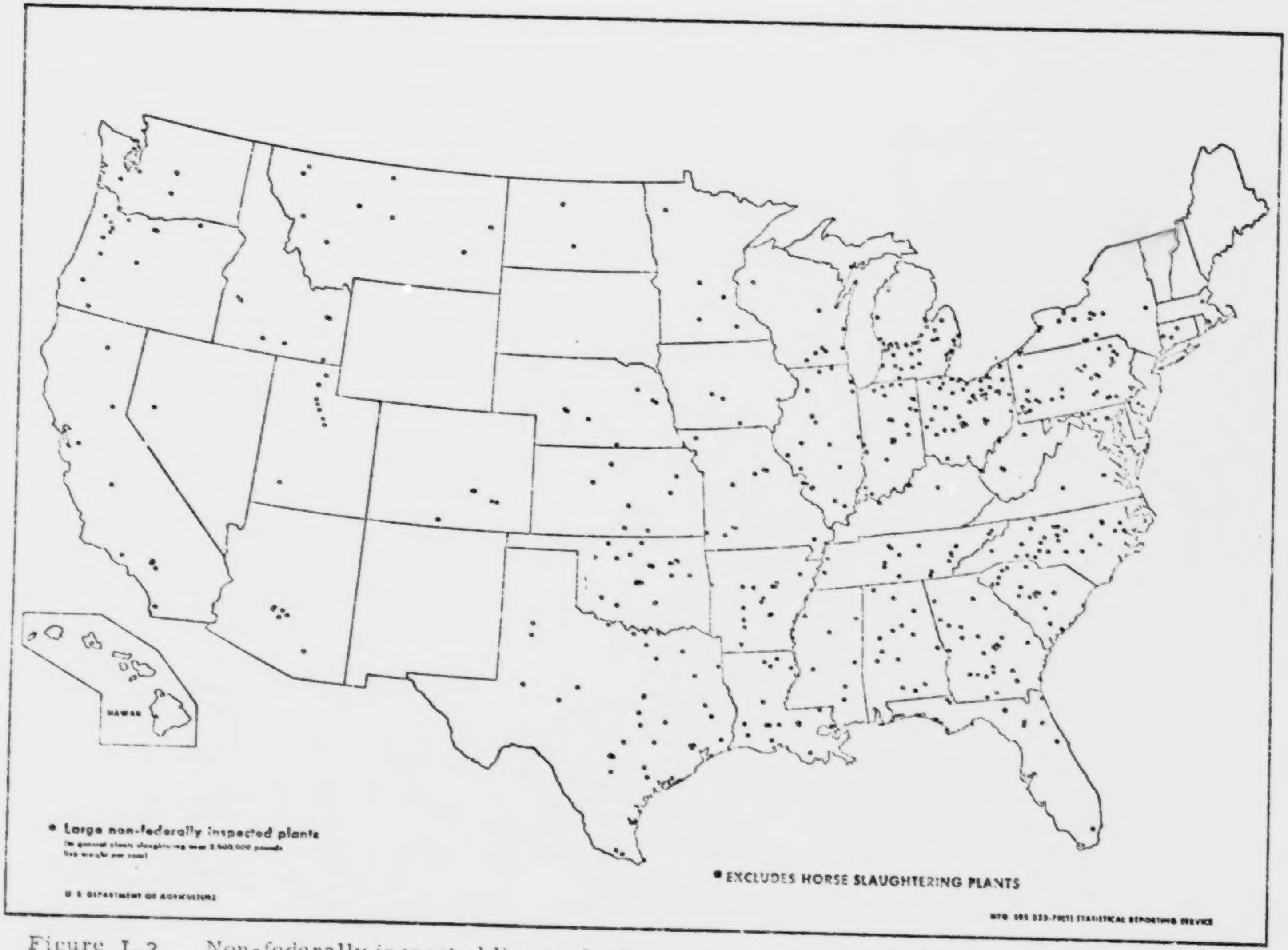

● Large non-federally inspected plants
(In general plants slaughtering over 2,000,000 pounds live weight per year)
U. S. DEPARTMENT OF AGRICULTURE
HAWAII
● EXCLUDES HORSE SLAUGHTERING PLANTS
NEG. [illegible] STATISTICAL REPORTING SERVICE

Figure I-2. Non-federally inspected livestock slaughtering plants,* slaughtering over 2,000,000 pounds annually.

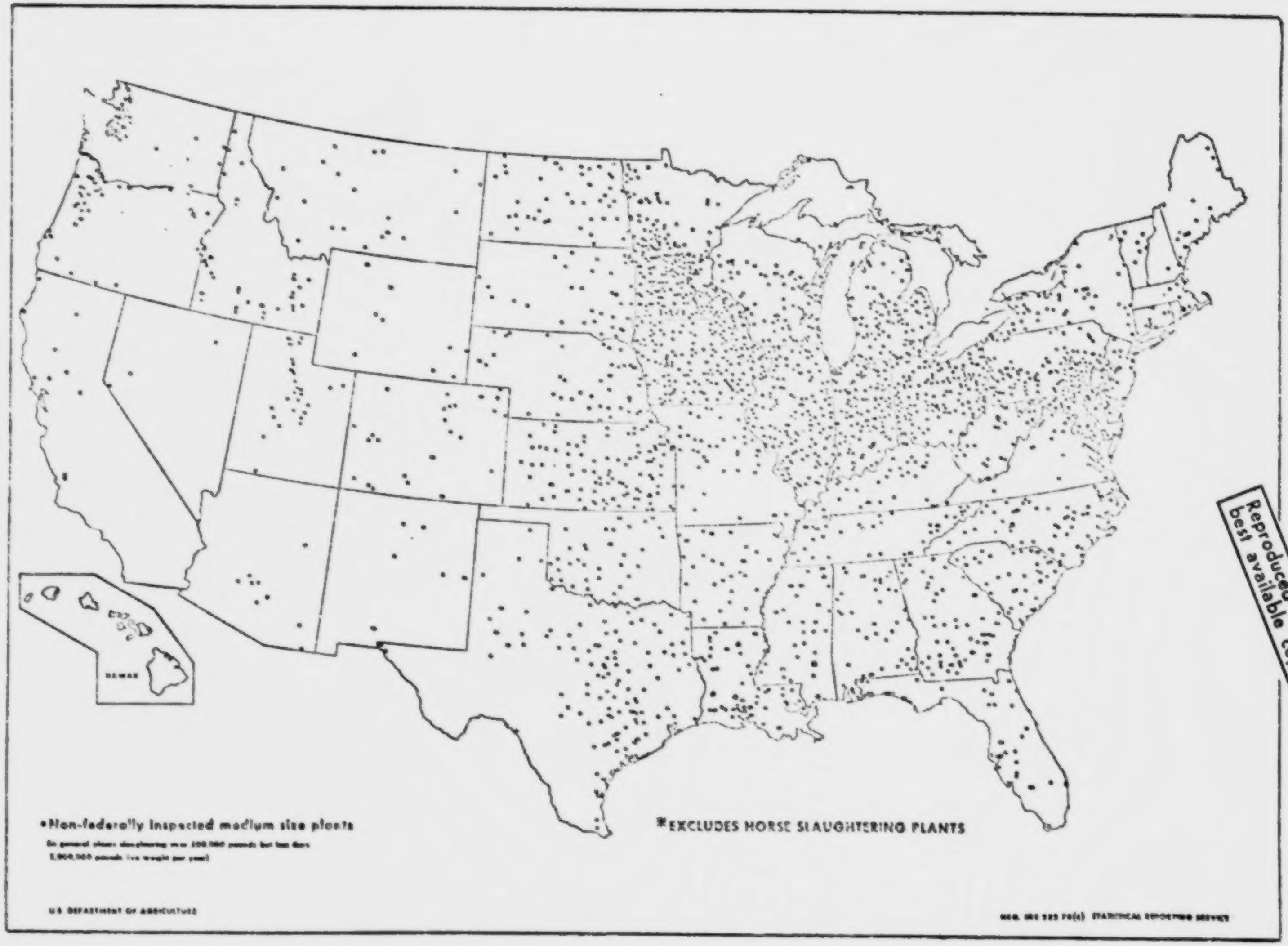

•Non-federally inspected medium size plants
*EXCLUDES HORSE SLAUGHTERING PLANTS
HAWAII
U.S. DEPARTMENT OF AGRICULTURE
STATISTICAL REPORTING SERVICE

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Figure I-3. Non-federally inspected livestock slaughtering plants,* March 1, 1970, slaughtering between 300,000 and 2,000,000 pounds annually.

Estimated Number of Plants Slaughtering Over 2,000,000 Pounds Annually

To limit the analysis to "commercial" packinghouses, only those plants slaughtering more than 2 million pounds live weight annually are included. This volume is equivalent to an average slaughter of seven 1,040-pound steers per day for a 260 day working year. This would characterize a very small plant and would represent a low limit for a "commercial" slaughter operation.

Estimates of the number of slaughter plants by size and type for 1973 were made from the following data: (1) the USDA estimates of plant size distribution, (2) an analysis of plant types from current lists of Federally-Inspected slaughter plants, (3) the 1973 USDA reports of the number of livestock slaughtering plants, Federally-inspected and other, and (4) the industry's historical trends. Demand projections were made for meat for 1973-1983, taking into account both population growth and income-induced demand expansion. Considering historical and projected size distribution among plants, the number and size of plants required to meet slaughter demands for plants with annual kill in excess of 2 million pounds was calculated. These plant numbers were used as the baseline case -- representative of the number of plants, assuming levels of effluent control presently prevailing in the industry and reductions in plant numbers resulting from the imposition of pollution controls were measured against this base. These baseline numbers are given in Table I-6.

Table I-6. Estimated number of meat packing and slaughter plants, by size and type, employing baseline effluent treatment levels, 1973, 1977 and 1983

Type and Size of Plant	Number of Plants 1973	1977	1983
Meat packinghouses			
Large and extra large	85	135	195
Medium	305	307	310
Small	750	695	640
Slaughterhouses			
Large and extra large	22	30	35
Medium	80	68	55
Small	178	144	110
Total number of plants with over 2 million lbs. LWK/Yr.	1,420	1,379	1,345

Small Meat Packing and Slaughter Plants

The economic impact analysis, which follows in this report, focuses on plants slaughtering in excess of two million pounds liveweight annually. In addition to these, 1,420 "commercial" plants, there were in 1973 approximately 2,000 small meat packers and slaughterers, plus an estimated 2,600 frozen food locker plants which slaughter for their patrons.

These small packers and slaughterers include retail butchers, custom slaughterers, institutions (universities, prisons, etc.) and low volume packers. Although there are large numbers of such slaughterers, their individual volume is small and in the aggregate they account for less than two percent of the total volume of livestock slaughtered annually.

These plants are located mainly in small communities. Apparently half of them may be discharging into municipal sewer systems. The status of effluent disposal for the remaining plants is unknown.

Frozen Food Locker Plants

Frozen food locker plants exist in every state. Primarily they rent frozen food storage space to their patrons, but many do custom killing of livestock and process sausage and other meat products as a service to their customers.

The Farmer Cooperative Service, USDA estimates that there are approximately 6,500 locker plants in the United States. The estimated geographic distribution of these plants is shown in Table I-7, and they are most numerous in the Midwest and the Great Plains.

The ten leading states, in terms of estimated number of frozen food locker plants in 1972, are as follows:

State	No. Plants
Iowa	656
Minnesota	407
Wisconsin	380
Illinois	363
Texas	361
Kansas	347
Missouri	324
California	273
Ohio	263
Indiana	249

Table I-7. Estimated Number of frozen food locker plants, by state, 1972[1]

State	No. Locker Plants	State	No. Locker Plants
Alabama	52	Montana	100
Alaska	12	Nebraska	330
Arizona	22	Nevada	5
Arkansas	75	New Hampshire	9
California	273	New Jersey	26
Colorado	117	New Mexico	29
Connecticut	12	New York	77
Delaware	9	North Carolina	72
Florida	41	North Dakota	168
Georgia	91	Ohio	263
Hawaii	3	Oklahoma	187
Idaho	122	Oregon	108
Illinois	363	Pennsylvania	172
Indiana	249	Rhode Island	5
Iowa	656	South Carolina	29
Kansas	347	South Dakota	151
Kentucky	60	Tennessee	65
Louisiana	22	Texas	361
Maine	9	Utah	72
Maryland	14	Vermont	26
Massachusetts	14	Virginia	27
Michigan	170	Washington	247
Minnesota	407	West Virginia	14
Mississippi	53	Wisconsin	380
Missouri	324	Wyoming	60
		Total	6,500

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[1] Estimated from an analysis of the membership of the National Institute of Locker and Freezer Provisioners and from estimates of the Farmer Cooperative Service, U.S.D.A.

Slaughtering and Meat Processing: Approximately 40 percent (2600 locker plants) slaughter livestock as a service to their members and over 90 percent process meat and poultry. [1] Thirty percent buy livestock for slaughter and resale to their customers, and 65 percent sell packer-slaughtered meat in wholesale cuts. Ninety percent cut, wrap and freeze meats on a custom basis.

In terms of their volume of livestock slaughtered, however, locker plants are relatively insignificant. The average plant slaughters less than 1000 head of cattle and calves annually. Assuming that slaughter was 60 percent hogs and 40 percent cattle (by number), the total annual liveweight kill of an average locker plant would be approximately a half million pounds per year. The 2,600 plants, thus accounted for slightly over 2 percent of total U.S. slaughter in 1972.

Effluent Disposal: No information is available concerning the current status of effluent disposal by these locker plants, many of which would normally use more dry clean up practices than would meat packers who have steam available for equipment cleaning. The principal pollutants in the effluents of locker plants would be blood and wash waters. Those locker plants located in towns and cities having adequate municipal sewage disposal systems, can discharge their liquid wastes into sewers, but plants located in rural areas and in small towns may dump their effluents into streams or use ground disposal systems, with or without pretreatment. Some plants have lagoon systems although their number is not known.

Distribution of locker plants, by size of town in which located, in 1965, was as follows:

Population of Town	Percentage of total no. plants
1,000 and under	36
1,001 - 5,000	33
5,001 - 10,000	9
10,001 - 25,000	10
Over 25,000	12

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[1] Seymour, William R. and Bert D. Miner, "An Appraisal of Frozen Food Locker and Freezer Provisioning Cooperatives, 1965," General Report 139, Farmer Cooperative Service, U.S.D.C.

Employment in the Meat Packing Industry

Employment in the meat packing industry has declined during the past decade as new, more highly automated plants and more efficient processing systems have increased the productivity of plant labor.

Year	All employees (000)	Production workers (000)
1954	220.2	167.8
1958	201.2	150.9
1963	181.0	138.8
1967	170.5	130.8
1972	157.5	122.9

Source: U.S. Department of Commerce - Census of Manufactures.

Approximately 78 percent of all employees in the meat packing industry are classified as "production" workers. This is substantially above the average for all food industries where production workers represent approximately 66 percent of total employment.

Selected, labor-related operating ratios further reflect the increasing productivity of packinghouse labor.

Year	Production workers as % of total	Value added per employee	Payrolls as % of value added	Value added per man/hr.of prod. workers
1954	76%	$ 6,333	68%	$ 3.93
1958	75	8,702	61	5.66
1963	76	10,551	60	6.60
1967	77	13,023	57	8.05
1972	78	18,771	52	11.64

Source: U.S. Department of Commerce - Census of Manufactures.

As shown by these data, production workers as a percent of total employees has risen -- from 76 percent in 1954 to 78 percent in 1972, value added per employee has tripled -- from $6,333 in 1954 to $18,771 in 1972, payrolls as a percent of value added have decreased -- from 68 percent in 1954 to 52 percent in 1972, and value added per man hour of production worker has increased from $3.93 to $11.64 over the 1954-1972 period.

The increasing productivity of labor in the industry is further shown by the fact that expenditures for wages and salaries, as a percentage of the total meat sales dollar, decreased from 13.1 percent in 1960 to 8.5 percent in 1972.

Table I-8 distributes employment by number of employees per plant for 1958, 1963 and 1967. During 1958-1967, employment patterns changed. Employment in the very small (under 20 employees) and the very large (over 1,000 employees) plants declined both in absolute numbers and in its percentage of total industry employment. Medium-sized plant employment increased. The greatest relative (6.3 percent) and absolute (2,800 employees) gains were made by plants employing between 100 and 499 employees. The greatest loss (4.7 percent and 4,700 employees) was in the 1,000-2,499 employee plant size. However, since 1954, the largest sized plants have lost the most employees. In 1954, plants with over 2,500 employees accounted for 59,700 employees, or 27.1 percent of the total. In 1967, this group of plants employed only 26,100 employees or 15.3 percent of the total, a decrease of over 50 percent from 1954 to 1967.

In the meat packing industry, most plants (65 percent in 1967) have fewer than 20 employees and account for only 4.5 percent of total industry employment. At the other end of the scale, 8 large plants (0.3 percent by number) employed 15.3 percent of the industry total in 1967.

Wages, Labor Organization and Skill Levels

Wages in the meat packing industry are relatively high, averaging 17 percent above the average for all manufacturing industries. In terms of total payrolls, average annual wages in 1967 ranged from $5,300 in small plants to over $8,000 in large plants. The distribution of wages in 1967 was as follows:

No. employees per plant	Average annual wage
1-4	$5,353
5-9	5,500
10-19	5,366
20-49	6,060
50-99	6,450
100-249	6,971
250-499	7,537
500-999	7,701
1,000-2,499	8,044
2,500+	8,321

Source: U.S. Department of Commerce, Census of Manufacturers.

Table I-8. Employment in the meat packing industry, employees per plant, by size group, 1958, 1963, 1967[1/]

Number of employees	Meat Packing											
	1967				1963				1958			
	No. plants	%	Em-ployees (000)	%	No. Plants	%	Em-ployees (000)	%	No. plants	%	Em-ployees (000)	%
Less than 20	1,742	64.6	7.6	4.5	2,016	67.4	9.9	5.5	1,824	65.1	10.0	5.0
20-99	641	23.8	28.6	16.8	677	22.6	29.2	16.1	668	23.8	29.0	14.4
100-499	253	9.4	54.3	31.9	232	7.8	49.8	27.5	231	8.2	51.5	25.6
500-999	30	1.1	22.1	13.0	34	1.1	24.7	13.6	38	1.4	26.1	13.0
1,000-2,499	23	0.8	31.7	18.5	24	0.8	36.5	20.1	30	1.1	46.5	23.2
2,500 or more	8	0.3	26.1	15.3	9	0.3	31.1	17.2	10	0.4	37.7	18.8
Total	2,697	100.0	170.5	100.0	2,992	100.0	180.9	100.0	801	100.0	200.8	100.0

[1/] Source: U.S. Department of Commerce, Census of Manufacture 1967, 1963, 1958.

A 40-hour week is typical for most meat packing plants, with time and a half being paid for work beyond an eight-hour day or a 40-hour week. Wage differentials are also generally paid to employees working on late shifts. In addition, labor contracts generally have provisions for a minimum work week, with pay for 36 hours guaranteed.

Plants with collective bargaining agreements covering a majority of production workers employ over 80 percent of the workers in the meat packing industry. Union membership is somewhat higher in the plants of multi-plant companies than in the single-plant firms. The Amalgamated Meat Cutters and Butchers Workmen of North America, the United Packinghouse, Food and Allied Workers and the National Brotherhood of Packinghouse and Dairy Workers are the major industry unions.

Worker skill levels vary in the industry. Although many manual operations have been semi-mechanized, many processes still demand a high degree of manual dexterity and skill. Skinning, cutting, trimming, boning, carcass breaking and similar operations require skilled workers to achieve efficient operation and to produce a quality product.

II. FINANCIAL PROFILE OF THE MEAT INDUSTRY

Earnings

As the 1972 analysis of 40 major industry groups by the First National City Bank of New York indicating that the meat packing industry ranked 40th in return on sales and 39th in return on net worth shows both the meat packing and the meat processing industries are characterized by high dollar sales volumes and low sales dollar earnings.

The American Meat Institute annually collects and analyzes industry financial data. Ratios of earnings to sales, earnings to total assets, and earnings to net worth are calculated for national, regional, sectional and local packers. Table II-1 shows these earnings ratios for the meat packing industry, 1959-1972.

Earnings-to-sales: Over the 13 years, 1959 through 1972, meat packers earned approximately one percent returns on sales (the return in 1972 was 0.8 percent). There was little variation in earnings among the different sizes of packers--small local and sectional packers averaged slightly higher earnings on sales than did the large regional and national packers (Table II-1). Returns were generally low during the early 1960's, but 1971 was one of the most profitable years on record because of the record volumes of meat processed and the slight decline in costs of raw materials relative to prices of finished products. However, returns dropped sharply in 1972 due to competitive pressure to obtain livestock, increased operating expenses and government price controls.

Earnings-to-total-assets: Rates of return on total assets over the 1959-1972 period averaged 5.02 percent (Table II-1). Returns relative to assets in 1972 for national packers (3.70 percent) were substantially lower than those for regional (4.51 percent), sectional (5.41 percent) but were above returns for local packers (3.09 percent). Again, 1971 was one of the more profitable years on record as earnings-to-total-assets averaged 6.03 percent but the ratio dropped to 3.93 in 1972.

Earnings-to-net-worth: The ratio of earnings-to-net-worth for the meat and packing industry averaged 8.28 percent over the 1959-1972 period (Table II-1 and Figure II-1). Again, earnings of large, national packers were lower than those of other groups. Earnings in 1971 were among the highest on record, averaging 11.23 percent, but they dropped substantially in 1972 (7.41 percent).

Table II-1. Earnings ratios for meat packing companies, 1959-1972 1/

Year	Earnings to sales				Earnings to total assets				Earnings to net worth			
	National Packers	Regional Packers	Sectional Packers	Local Packers	National Packers	Regional Packers	Sectional Packers	Local Packers	National Packers	Regional Packers	Sectional Packers	Local Packers
	%	%	%	%	%	%	%	%	%	%	%	%
1972	.88	.65	1.07	.68	3.70	4.51	5.41	3.09	6.81	9.34	8.53	5.63
1971	1.42	1.06	1.88	1.40	5.60	7.15	9.31	6.36	10.37	13.79	15.96	10.55
1970	1.19	.75	1.23	1.16	5.25	4.83	6.37	6.20	10.42	9.46	10.88	10.45
1969	.92	.77	1.05	.78	4.10	5.41	5.26	3.85	8.19	10.76	8.75	6.30
1968	.96	.82	1.16	.61	4.25	5.49	6.73	2.93	8.32	9.50	9.96	5.01
1967	1.02	.98	1.25	1.26	4.27	6.59	6.76	6.08	8.22	11.18	10.70	9.23
1966	.59	.63	.92	1.21	2.70	4.38	5.28	6.02	5.07	7.87	8.54	9.14
1965	.65	.85	1.36	.56	2.84	5.44	7.59	2.64	4.69	8.71	10.61	4.22
1964	1.09	1.19	1.32	1.17	4.85	7.38	7.31	5.63	8.22	11.61	10.95	8.40
1963	.70	.88	1.13	1.18	3.18	5.31	6.11	5.61	5.34	7.87	8.89	7.88
1962	.65	.85	1.04	.93	3.01	5.18	6.03	4.51	5.05	7.87	8.93	5.74
1961	.56	.61	.75	1.13	2.59	3.67	4.24	6.26	4.37	5.32	6.21	8.18
1960	.78	.81	.86	.93	3.61	4.89	5.14	4.71	5.92	7.08	7.43	6.65
1959	.95	1.11	1.11	1.14	4.59	6.84	6.80	5.96	7.64	9.63	9.61	8.46
Average	.88	.85	1.15	1.01	3.90	5.51	6.31	4.99	7.05	9.29	9.71	7.56

1/ Source: "Financial Facts About the Meat Packing Industry," American Meat Institute, annual issues, 1961-1972.

2/ Earnings after tax.

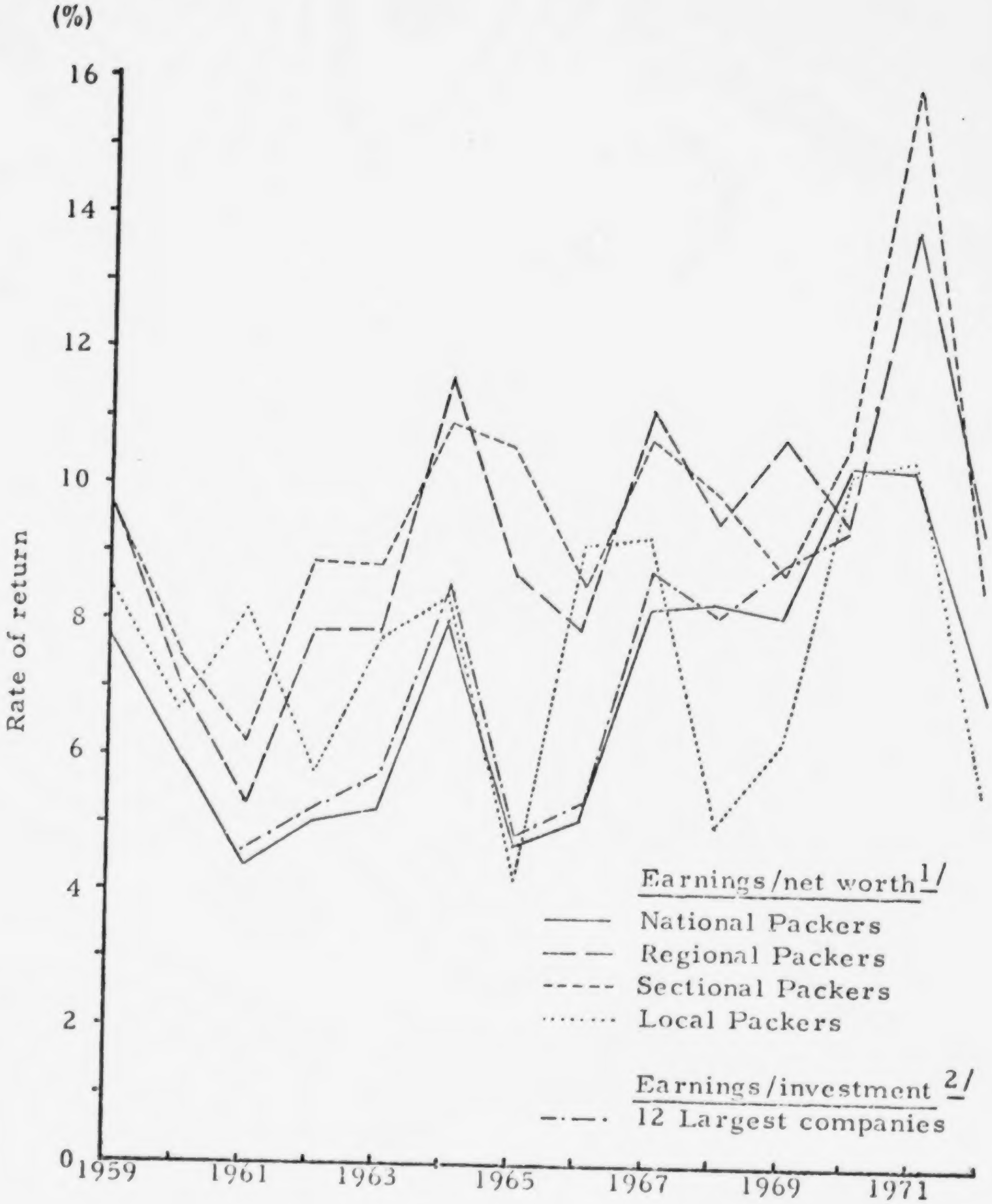

Figure II-1. Rates of return on net worth[1] and on stockholders' investment[2], meat packers, 1959-1971.

[1] Source: "Financial Facts about the Meat Packing Industry", American Meat Institute.

[2] Source: "Report of the Federal Trade Commission on Rates of Return in Selected Manufacturing Industries, 1961-1970", Federal Trade Commission.

Earnings - Major Meat Packing Firms

The Federal Trade Commission publishes information on rates of return on stockholders' investment for the 12 leading firms in 35 selected industries, including the meat industry. [1] These data are as follows:

Table II-2. Rates of return on stockholders' investment (after taxes) for major firms in the meat products industry[1]

Year	Companies ranked 1-4 (%)	Companies ranked 5-8 (%)	Companies ranked 9-12 (%)	Total 12 companies (%)
1961	5.0	4.5	0.1	4.6
1962	5.6	4.2	3.6	5.2
1963	5.8	4.6	7.4	5.7
1964	8.2	10.1	7.4	8.5
1965	5.5	4.0	-1.5	4.8
1966	6.3	5.5	-9.2	5.3
1967	8.0	15.6	7.0	8.8
1968	7.3	14.5	8.8	8.1
1969	8.3	13.4	6.1	8.9
1970	9.3	9.9	9.7	9.4

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[1] Report of the Federal Trade Commission on Rates of Return in Selected Manufacturing Industries, 1961-1970, Federal Trade Commission.

Table II-3. Distribution of total sales dollar, expenses and earnings in the meat packing industry, 1959-1971 [1]

	Year												
	1971	1970	1969	1968	1967	1966	1965	1964	1963	1962	1961	1960	1959
Total sales	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Cost of livestock and other raw materials	75.5	77.0	76.8	76.1	75.8	77.7	75.0	72.9	73.7	74.1	73.7	72.7	73.5
Gross margin	24.5	23.0	23.2	23.9	24.2	22.3	25.0	27.1	26.3	25.9	26.3	27.3	26.5
Operating expenses													
Wages and salaries [2]	9.6	9.5	9.7	10.0	10.0	9.6	10.9	11.7	11.5	11.5	12.7	13.1	12.6
Employee benefits	2.0	1.9	1.9	1.9	1.8	1.8	1.8	1.9	2.0	1.9	1.1	1.1	.9
Interest	.3	.4	.3	.3	.3	.2	.2	.2	.2	.2	.2	.2	.2
Depreciation	.8	.7	.7	.8	.8	.7	.8	.8	.8	.8	.8	.8	.8
Rents [3]	.3	.3	.3	.3	.3	.3	.4	.4	.3	.2			
Taxes [4]	.3	.3	.3	.3	.3	.3	.3	.3	.3	.3	.3	.3	.3
Supplies and containers	3.3	3.2	3.3	3.3	3.4	3.1	3.5	3.8	3.8	3.7	3.9	4.0	3.9
All other expenses	5.2	4.8	5.0	5.3	5.6	5.1	5.7	6.0	5.9	5.8	6.1	6.2	5.8
Total operating expenses	21.8	21.1	21.5	22.2	22.5	21.1	23.6	25.1	24.8	24.4	25.1	25.7	24.5
Earnings before taxes	2.7	1.9	1.7	1.7	1.7	1.2	1.4	2.0	1.5	1.5	1.2	1.6	2.0
Income taxes	1.2	.9	.8	.8	.7	.5	.6	.9	.7	.7	.6	.8	1.0
Net earnings	1.5	1.0	.9	.9	1.0	.7	.8	1.1	.8	.8	.6	.8	1.0

[1] Source: "Financial Facts About the Meat Packing Industry," American Meat Institute, annual issues.

[2] Vacation, holidays and sick leave not reported separately until 1962 and was included in wages and salaries in previous years.

[3] Rents not reported separately until 1962 and were included in all other expenses in previous years.

[4] Other than social security and income taxes

Federal Trade Commission reports on returns on stockholders investment for the 12 largest companies in the meat packing industry show significant relationships:

1. The 4 largest firms were less profitable on the average (6.9%) than were the 5th through the 8th largest (8.6%), but were more profitable than the 9th - 12th largest firms (3.9%).
2. Although the profitability of four largest firms was average, their profit levels were more stable than those of the other 8 leading firms.
3. During the period 1967-1970, the middle group of firms averaged 13.4 percent return compared to 8.2 percent for the first four firms and 7.9 percent for the 9th through 12th largest firms.

Distribution of Total Sales Dollar

The industry's expense and earnings distribution of the total sales dollar is shown in Table II-3. The data indicate that the meat packing industry characteristically has high raw material costs--75 percent of total costs and that wages and salaries constitute about half of all other operating expenses. Since 1959 automation and improved product handling methods have enabled the meat packing industry to reduce labor input from 13 percent of the sales dollar to 8.5 percent. However, relative increases in livestock and other raw material costs have offset labor savings.

Industry Annual Cash Flow

"Annual cash flow," as used in this report indicates earnings after taxes plus depreciation allowances. Total industry estimates of these statistics have been calculated by the American Meat Institute since 1947. These data are shown in Table II-4.

Table II-4. Annual cash flows, meat packing industry, 1947-1971, millions $[1]

Year	Earnings after tax	Depreciation	Cash flow	Year	Earnings after tax	Depreciation	Cash flow
1972	$207	$184	$391				
1971	305	175	480	1959	$136	$100	$236
1970	227	165	392	1958	77	90	167
1969	187	153	340	1957	79	83	162
1968	165	143	308	1956	113	78	191
1967	178	136	314	1955	105	75	180
1966	117	128	245	1954	48	65	113
1965	126	124	250	1953	86	61	147
1964	165	112	277	1952	52	60	112
1963	117	115	232	1951	84	60	144
1962	112	108	220	1950	89	52	141
1961	84	109	193	1949	61	48	109
1960	110	102	212	1948	96	42	138
				1947	152	32	184

[1] Source: American Meat Institute, "Financial Facts about the Meat Packing Industry."

The cash flows shown in Table II-4 indicate a steadily increasing cash flow trend in the industry from $193 million in 1961 to $506 million in 1971. Depreciation has increased steadily, from $32 million in 1947 to $176 in 1971, and shows increasing industry capital investment. Depreciation, as a percent of total sales, increased from 0.4 percent in 1947 and 1948 to the range of 0.7 to 0.8 percent in recent years. Earnings on sales after tax have been more variable, ranging from a low of $48 million (0.4 percent) in 1954 to a high of $305 million (1.5 percent) in 1971.

Cash Flows and Internal Rates of Return: Representative Plants

In order to provide a base from which to measure the impact of water pollution controls on the meat industry, it was necessary to define "representative" plants and to synthesize investments, operating costs, working capital requirements, revenues and cash flows for these plants. Given these data, fully discounted internal rates of return were calculated for each type of plant with varying assumptions as to size and investment cost basis. All plants were assumed to operate at 85 percent of capacity on a single-shift, 5-day week.

Types of Plants

Models were developed for two basic types of plants:

1. Meat packinghouses (those which both kill and process cattle and hogs)

2. Specialized slaughter plants (those which kill and sell carcasses and raw by-products only but do not process)

    a. Cattle slaughter plants
    b. Hog slaughter plants
    c. Cattle and hog slaughter plants

Sizes of Plants

For each type of plant, three sizes were specified: Large, medium and small, as follows:

Meat packinghouses:

Large - kill 280 million pounds liveweight annually (equivalent to 144 head of cattle and 625 head of hogs per hour) and process 50 million pounds of product annually.

Medium - kill 140 million pounds liveweight annually (equivalent to 72 head of cattle and 312 head of hogs per hour) and process 25 million pounds of product annually.

Small - kill 23 million pounds of liveweight annually (equivalent to 6 head of cattle and 52 head of hogs per hour) and process 5 million pounds of product annually.

Specialized slaughter plants:

Large - kill 280 million pounds liveweight annually.

Cattle slaughter plants: equivalent to slaughtering 144 head of cattle per hour.

Combined cattle and hog slaughter plants: equivalent to slaughtering 72 head of cattle and 312 head of hogs per hour.

Medium - kill 140 million pounds liveweight annually.

Cattle slaughter plants: equivalent to slaughtering 72 head of cattle per hour.

Combined cattle and hog slaughter plants: equivalent to slaughtering 36 head of cattle and 156 head of hogs per hour.

Small - kill 23 million pounds liveweight annually.

Cattle slaughter plants: equivalent to slaughtering 12 head of cattle per hour.

Combined cattle and hog slaughter plants: equivalent to slaughtering 6 head of cattle and 26 head of hogs per hour.

Investment Assumptions

Cash flows and rates of return were run on the basis of two different investment assumptions for each plant.

1. Full replacement cost - equivalent to 100 percent of the cost of land, buildings and equipment for a new plant.
2. Ten percent of replacement cost plus original value of land - equivalent to the salvage value of a plant whose site has a significant value for other uses.

Utilization

For the purposes of this analysis all plants were assumed to operate typically at 85 percent of capacity. Obviously a new, well-located slaughter or meat packing plant could operate at 100 percent of capacity, or even above 100 percent through double shift operation, but 85 percent was judged to be a reasonable performance rate.

Description of Model Plants and Products Handled

Beef Slaughter Plants

The prototype beef slaughter plants for all three sizes do no more than slaughter and chill cattle for out-plant processing. Their entire output is shipped as sides of carcass beef. The analysis is based on 1,040-pound U. S. choice slaughter steers. The delivered purchase cost of $319.70 per head is based on the 1968-72 average price of $30.74 cwt. for the seven Midwest markets.

The average chilled dressing percentage is taken at 61.06 percent, making a 635-pound carcass weight. Average carcass sales revenue is $333.39 per head, based on the 1968-72 average price of $48.80 cwt. at the Midwest, Iowa and Missouri River markets. By-product value is taken at $23.51 per head, based on 1968-72 average prices. The total base slaughter margin is $13.69 per head.

The small plant is assumed to realize a slight locational advantage with respect to both livestock supplies and product markets. Livestock costs are taken at one percent less than the base cost, and product prices are taken at one percent more than the base sales price.

Beef and Pork Slaughter Plants

The dual-species slaughter plants, also, do no more than slaughter and chill carcasses for out-plant processing. The small plant operates with only one crew which slaughters one species for half its shift and the other for the remaining shift time. The two larger prototype plants operate with separate and concurrent crews for the two species.

The livestock weights and costs, the yields, and the product values are the same as those for the specialized slaughter plants. Locational advantages for the small plant are assumed to be two percent on both raw material costs and product prices. A locational advantage of one percent on raw material costs is assumed for the medium-sized plant.

Meat Packinghouses

The prototype plants for slaughtering and processing both species represent combinations of beef-pork slaughter-processing plants. The sales product mix is the same as that shown in Table II-5. Additionally, these plants handle fresh beef and pork carcasses.

The revenue for these plants is calculated by adding the total sales of the beef-pork slaughter operation and the total sales for the processed products less the cost of raw materials for processing.

Plant Categories

Slaughterhouses and packinghouses were further categorized by the extent to which they processed by-products.

Simple Slaughterhouse--one that does limited amounts of by-product processing (i.e., secondary processing). Usually no more than two

Table II-5 Product mix and margins for processing plants

Product	Volume (percent)	Yield (percent)	Sales Price ($/cwt)	Cost Price ($/cwt)	Gross Margin/ cwt/sales ($/cwt)
Regular hams	8.278	108.91[a]	47.63	43.54	7.65
Boneless hams	9.817	89.85[b]	70.00	52.76	17.24
Other smoked products	2.695	108.91[a]	36.33	29.00	9.70
Fresh sausage	7.700	103.09[c]	40.96	22.94[e]	18.71
Bacon	17.710	108.91[a]	59.75	37.54[f]	25.28
Franks	15.400	120.05[d]	53.37	31.38	27.23
Bologna	9.620	120.05[d]	39.64	27.36	16.85
Lunch loaf	5.780	120.05[d]	50.52	25.51	29.27
Canned & misc.	23.000	108.91[a]	47.63	43.54	7.65
	100.000				

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[a] 1/1.009 x .91

[b] .825/1.009 x .91

[c] 1/.97

[d] 1/.833

[e] Lean trim containing a maximum of 50% fat.

[f] Bacon cost price is skinless basis calculated as 105% of the skin on price for seedlings green bellies.

secondary processes, such as rendering, paunch and viscera handling, blood processing, or hide or hair processing are carried out.

Complex Slaughterhouse--one that does extensive by-product processing (i.e., secondary processing). It usually carries out at least three of the secondary processes listed above.

Low-Processing Packinghouse--one that normally processes less than the total animals it slaughters but may process up to the total killed.

High-Processing Packinghouse--one that processes its total kill as well as purchased carcasses.

By-Product Operations--Assumptions

The by-product assumptions for the sizes and types of plants analyzed were as follows:

1. Simple Slaughterhouse
    - a. Small--processes no by-products and sells all of fat and hides
    - b. Medium--renders - inedible, dry process dry salt hides
    - c. Large--no large plants in this category.
2. Complex Slaughterhouse
    - a. Small--no small plants in this category
    - b. Medium--edible rendering - dry process
      inedible rendering - dry process
      dry salt hides
    - c. Large--edible rendering - dry process
      inedible rendering - dry process
      dry salt hides
      processes blood meal
3. Low-process Packinghouse
    - a. Small--edible rendering, dry process
    - b. Medium--edible rendering, dry process
      inedible rendering, dry process
      dry salt hides

c. Large--edible rendering, dry process
inedible rendering, dry process
dry salt hides
processes blood meal.

4. High-process Packinghouse

By-product processing - for all sizes - same as low-process packinghouse.

High-process packinghouse limited to firms primarily engaged in pork processing.

The balance of this chapter defines and describes the terms and assumptions underlying this analysis' base guide projection. Relying upon published data and accepted analytic procedures, the base guide projections for income structure and flow, asset values, and cost structures were calculated as described below.

Annual Throughput

The annual throughput used as the basis for the revenue, cost, and gross profit calculations for the prototype slaughter plants is shown in Table II-6. Three output levels are shown (1) full capacity operation, (2) 85 percent of capacity and (3) 70 percent of capacity. The capacity figures assume one-shift operations of 7.5 hours of productive slaughter time per day for a 250 operating day year. The small beef-pork slaughter plant operates with one killing crew for both species, operating each line for four hours.

Annual throughput for the meat packing plant is based on the following, at 85 percent capacity:

	No. Head	Million Pounds
Large Plant		
Cattle slaughtered	114,750	119.3
Hogs slaughtered	498,047	117.0
Processed meats	-	42.5
Medium Plant		
Cattle slaughtered	57,375	59.7
Hogs slaughtered	248,625	58.4
Processed meats	-	21.2
Small Plant		
Cattle slaughtered	9,562	9.9
Hogs slaughtered	41,438	9.7
Processed meats	-	4.2

Table II- 6 . Annual throughput conditions for model slaughter plants

		Annual Kill Volume[a]					
		Full Capacity		85% Capacity		70% Capacity	
Plant Size	Capacity (hd/hr)	No. Head	mil. lbs.	No. Head	mil. lbs.	No. Head	mil. lbs.
				Beef Plants			
Small	12	22,500	23.4	19,125	19.8	15,750	16.3
Medium	72	135,000	140.4	114,750	119.3	94,500	98.3
Large	144	270,000	280.8	229,500	238.6	189,000	196.5
				Hog Plants			
Small	52	97,500	22.9	82,875	19.4	68,250	16.0
Medium	312	585,000	137.4	497,250	116.8	409,500	96.2
Large	625	1,171,875	275.3	996,094	234.0	820,312	192.7
				Combined Beef and Hog Plants			
Small							
Beef	6[b]	11,250	11.7	9,562	9.9	7,875	8.2
Hogs	26[b]	48,750	11.5	41,438	9.7	34,125	8.0
Total			23.2		19.6		16.2
Medium							
Beef	36	67,500	70.2	57,375	59.7	47,250	49.1
Hogs	156	292,500	68.7	248,625	58.4	204,750	48.1
Total			138.9		118.1		97.2
Large							
Beef	72	135,000	140.4	114,750	119.3	94,500	98.3
Hogs	312	585,938	137.7	498,047	117.0	410.157	96.4
Total			278.1		236.3		194.7

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[a] Throughput calculated on the basis of 7.5 hours of productive operation per day.

[b] These capacities each operated for four hours per day, using the same killing crew.

Annual Profits

The pre-tax income, the return on average invested capital before and after taxes, and the after tax return-on-sales are shown in Table II-7 for those plant units analyzed.

Pre-tax income was derived as follows:

Gross sales
- raw materials cost (livestock or meat materials)
= gross margin
- direct and indirect operating expenses
= cash earnings
- depreciation and interest
= pre-tax income

Pre-tax returns on average invested capital varied directly with size of plant (Table II-7). Among specialized slaughter plants (non-processing units), hog slaughter plants were more profitable than beef slaughter plants, and the combined slaughter plant showed returns midway between those of the specialized plants. The addition of processing operations in the meat packing plants increased returns substantially above those of the specialized combined slughter-only plant. Although pre-tax returns on average invested capital appear high, a comparison of these calculated returns with reports from industry and IRS data indicate that they are within industry performance ranges.

These financial data were developed by combining published and unpublished source information and were checked against available information on industry financial ratios and other measures of industry financial performance to insure their credibility.

Average invested capital was calculated as follows:

Average fixed assets (1/2 of replacement cost)
+ total working capital
- current liabilities
= average invested capital.

Average fixed assets were estimated from previously published research (updated and adjusted for plant size and type), from engineering estimates of plant and equipment, and from industry information on new plant costs. These estimates, developed in the earlier EPA study by DPRA, were corroborated by meat plant architects and other authoritative consultants.

Table II-7. Pre-tax net income and rate of return on average invested capital and after tax return on sales for meat packing plants

Type and Size of Plan	Pre-tax Income ($000)	Pre-tax ROI* (%)	After tax ROI* (%)	After tax return on sales (%)
Simple Beef Slaughter				
Small	35	8.0	4.1	0.28
Medium	315	14.0	7.3	0.43
Complex Beef Slaughter				
Medium	322	14.1	7.3	0.44
Large	651	15.9	8.3	0.45
Simple Combined Slaughter				
Small	59	12.0	6.3	0.56
Medium	322	14.4	7.5	0.52
Complex Combined Slaughter				
Medium	330	14.5	7.5	0.52
Large	720	18.2	9.5	0.57
Meat Packing House				
Small	125	10.9	5.7	0.80
Medium	846	16.5	8.6	0.94
Large	1,998	21.7	11.3	1.11

* Average return on fixed investment calculated by financial statement method.

Working capital for slaughter operations was calculated from the formula WC = (2/52 . Raw Product Cost) + (1/12 · Annual Operating Expense). Working capital for processing operations was derived WC = (3/52 · Raw Product Cost) + (1/12 · Annual Operating Expense).

Current liabilities were estimated from industry performance ratios as reported by the American Meat Industry and the Almanac of Business and Industrial Financial Ratios, 1973 (Prentice-Hall, Inc.). The latter's ratios are derived from IRS data.

After-tax return on sales is also reported since this is the measure of returns commonly quoted by the meat packing industry.

Annual Cash Flow

Aggregate cash flow estimates for the meat packing industry, developed from American Meat Institute estimates, are shown in Table II-4, page II-7. As the data indicates, industry cash flows have increased steadily from 1961 to 1971.

Estimated annual cash flows (after-tax income plus depreciation) for the types and sizes of plants analyzed in this study are shown in Table II-8. As can be seen, cash flows differed little between equivalent sizes of specialized slaughter-only plants. However, the addition of cutting and processing operations resulted in cash flows for the meat packing plants which were double to triple those of the simple slaughter plants. Much the same situation existed when cash flow was measured as a percentage of average fixed investment. Although the medium and large packinghouses showed ratios substantially above those of slaughter plants, the small packinghouse had a cash flow/fixed investment ratio approximately equivalent to that of the slaughter-only plants.

Market Value of Assets

The market or salvage value of meat plants will vary widely from plant to plant, for they depend on the location, the age, and the condition of the plant and its equipment.

In common with most food processing plants, meat packing plants undergo periodic renovation, continuous repair and maintenance, and the replacement of their equipment as it wears out or becomes obsolete. In recent years, more stringent FDA enforcement inspection requirements and the concurrent stiffening of state inspection have forced many plants to either close or undergo extensive remodeling. This is seen in the fact that from

Table II-8. Estimated cash flow for meat packing plants.

	Annual Cash Flow ($000)	Cash Flow on Average Fixed Investment (%)
Simple Beef Slaughter		
Small	48	11.0
Medium	323	14.4
Complex Beef Slaughter		
Medium	331	14.5
Large	617	15.1
Simple Combined Slaughter		
Small	67	13.6
Medium	332	14.8
Complex Combined Slaughter		
Medium	342	15.0
Large	658	16.7
Meat Packing House		
Small	163	14.2
Medium	886	17.2
Large	1,826	19.9

1971 to 1973 the number of slaughter plants dropped from 6,400 to 5,991 as the number of Federally-inspected plants rose from 766 to 1,364. As a result of enforcement policies existing plants are in a better condition and are better equipped than was true in past years.

Estimated replacement (new plant and equipment) value and working capital requirements for meat packing plants are shown in Table II-9. It is recognized that the market value and/or the salvage value of a meat packing plant will, in most instances, be substantially below its replacement value.

Old packing plants were often multi-level with product flow by gravity. Newer plants are generally essentially single-level plants which move products on powered conveyors. However, whether old or new, meat packing and slaughter plants are special-purpose facilities whose market value (except possibly for refrigerated storage space) for purposes other than meat packing is usually low. In a few instances, modern plants which have been shut down by one firm have been sold to another (i.e., the new Armour plant at Emporia, Kansas purchased by Iowa Beef Processors), but even in these situations, the market value of the plant is usually substantially below its replacement cost. In many instances, the salvage value of old, obsolete plants will only equal site value. However, in some instances, e.g. in Chicago or Kansas City, old, obsolete plants built before 1900 occupied land which had relatively high industrial site values.

If unprofitable or marginally profitable plants that cannot absorb additional cost factors for pollution controls are forced to close, the salvage values of their buildings would be negligible, their equipment sell-off values low, and their site values solely dependent upon location factors.

Frequently, the value of a packinghouse, particularly a small one, is greater to its present owner than it would be to any potential buyer. In terms of "book value," the physical facilities and equipment may have been fully depreciated, or nearly so, but in terms of their "use value" to their present owners, these plants may represent very tangible assets--much greater than their market or their salvage value.

Since data are not available on actual salvage values for meat packing plants and since a "market" for plants which would be forced to close because of the added costs of water pollution control would be virtually non-existent, the impact analysis will use arbitrary assumptions. Thus, all operating capital will be recovered intact, land will be valued at its original cost, and buildings and equipment will be valued at 10 percent of their original value. The combined value of operating capital, land, buildings, and equipment will be considered a plant's salvage value.

Table II-9. Estimated replacement value and working capital requirements for meat packing plants

Type and size of plant	Replacement value of plant, equipment and site ($000)	Total working capital requirement ($000)	Current liabilities ($000)	Replacement value of total assets ($000)
Simple Beef Slaughter				
Small	586	262	117	731
Medium	2,812	1,517	675	3,654
Complex Combined Slaughter				
Medium	2,893	1,517	675	3,735
Large	4,842	3,004	1,337	6,509
Simple Combined Slaughter				
Small	728	233	104	857
Medium	3,002	1,333	593	3,742
Complex Combined Slaughter				
Medium	3,083	1,333	593	3,823
Large	4,995	2,617	1,165	6,447
Meat Packing House				
Small	1,797	453	202	2,048
Medium	7,610	2,403	1,069	8,944
Large	13,139	4,729	2,104	15,764

Cost Structure

Revenues and costs for large, medium and small specialized slaughter plants and meat packinghouses as specified in this project are given in Tables II-10 through II-12.

Raw materials costs were developed on the basis of the number and cost of animals slaughtered and, in the case of the processing packinghouses, the volume and cost of raw meat products (trimmings, green pork bellies, skinned raw hams, etc.) was included.

The following physical relationships were used:

Cattle - choice 1040 lb. steers
61.06 percent dressed yield
635 pound carcass weight

Hogs - 235 lb. slaughter barrows and gilts
70.2 percent dressed yield, packer style
165 pound carcass weight

Processed products, product mix, costs and prices were as shown on page II-11 of this report.

Direct and indirect operating costs were developed on the basis of estimates from published studies, up-dated and adjusted to plant types and sizes indicated, and checked against performance data from industry sources. In the case of meat packing plants, direct and indirect costs were aggregated due to a lack of data required for allocation between slaughter and processing operations.

Depreciation rates and interest costs for meat packing plants were based on indicated rates from industry sources and from the *Almanac of Business and Industrial Financial Ratios* which develops its data from IRS sources. For slaughter plants, depreciation was estimated by straight-line depreciation on estimated replacement cost. Interest was calculated in line with reported industry practices.

Cost Relationships

Raw product costs in meat processing include livestock and raw materials which constitute the largest single cost item in the meat industry, accounting for over 90 percent of total costs in specialized slaughter-only plants and 75 to 80 percent in meat packing plants. In general, raw product costs represent a slightly higher proportion of total costs in larger plants as

Table II-10. Estimated costs for beef slaughter plants

Item	Size of Plant							
	Complex Large		Complex Medium		Simple Medium		Simple Small	
	$000	(%)	$000	(%)	$000	(%)	$000	(%)
Sales	76,658	100.0	38,325	100.0	38,313	100.0	6,385	100.0
Raw materials cost	73,371	95.7	36,538	95.3	36,538	95.4	6,053	94.8
Direct operating cost	1,485	1.9	736	1.9	736	1.9	116	1.8
Indirect operating cost	698	0.9	456	1.2	456	1.2	121	1.9
Depreciation	278	0.4	164	0.4	159	0.4	30	0.5
Interest	175	0.2	109	0.3	109	0.3	30	0.5
Total before tax cost	76,007	99.2	38,003	99.1	37,998	99.2	6,350	99.5

Table II-11. Estimated costs for combined beef and hog plants

Item	Size of Plant							
	Complex Large		Complex Medium		Simple Medium		Simple Small	
	$000	(%)	$000	(%)	$000	(%)	$000	(%)
Sales	65,971	100.0	32,959	100.0	32,946	100.0	5,528	100.0
Raw materials cost	62,320	94.5	31,077	94.3	31,077	94.3	5,122	92.7
Direct operating cost	1,714	2.6	836	2.5	836	2.5	138	2.5
Indirect operating cost	745	1.1	425	1.3	425	1.3	136	2.5
Depreciation	284	0.4	170	0.5	165	0.5	36	0.7
Interest	188	0.3	121	0.4	121	0.4	37	0.7
Total before tax cost	65,251	98.9	32,629	99.0	32,624	99.0	5,469	98.9

Table II-12. Estimated costs for packing house plants.

Item	Size of Plant					
	Large		Medium		Small	
	$000	(%)	$000	(%)	$000	(%)
Sales	93,923	100.0	46,930	100.0	8,133	100.0
Raw materials cost	73,671	78.4	36,315	78.4	6,353	78.1
Direct operating cost ⎤ Indirect operating cost ⎦	15,905	18.0	8,541	18.2	1,508	18.5
Depreciation	786	0.8	446	1.0	98	1.2
Interest	563	0.6	232	0.6	49	0.6
Total before tax cost	91,925	97.9	46,084	98.2	8,008	98.5

administrative overhead and other fixed operating costs are spread over a correspondingly larger volume of production. In meat packing plants, the cutting, breaking, boning, and processing operations all require additional amounts of labor. Additionally meat product processing requires containers, spices, and non-meat ingredients and supplies.

Direct operating costs for slaughter plants include production labor costs and related employee benefits, utilities, miscellaneous supplies and materials, and other variable cost items. Labor is by far the most important component of direct operating costs, accounting for over 70 percent of the total in beef slaughter plants and over 50 percent for hog slaughter plants. In general, labor accounted for a higher proportion of direct operating cost in larger plants than it did in smaller plants.

Indirect operating costs for slaughter plants include salaries of officers and other supervisory or administrative personnel and such other fixed costs as taxes, insurance and repairs. Again, salaries and related fringe benefits represent the greatest part of indirect operating costs, accounting for 70 to 80 percent of indirect costs. Again, the percentage was higher for small plants than large plants.

Operating expenses for meat packing plants (both direct and indirect) accounted for approximately 18 percent of the total packer's sales dollar.

	Percent of packer's sales dollar		
Operating cost item	Large Packer (%)	Medium Packer (%)	Small Packer (%)
Wages	8.0	8.5	9.0
Employee benefits	2.0	2.0	2.0
Officers' compensation	0.8	1.0	1.5
Repairs	0.8	0.8	0.8
Taxes	1.4	1.4	1.2
Advertising	1.5	1.0	0.5
Other expenses	3.5	3.5	3.5
Total	18.0	18.2	18.5

Depreciation and interest were treated as separate cost items and were based on reported industry rates.

Constraints on Financing Additional Capital Assets

Constraints on financing additional capital required for water pollution control facilities will vary greatly from firm-to-firm and from location-to-location. Investments range from less than 10 percent of plant value for large plants to 20-30 percent for small plants.[1]

In general, there are no serious constraints in securing the capital required for pollution control for large and medium size meat packing or slaughtering plants. However, the availability of capital is not always the primary determinant. Plant profitability, age, equipment condition, or location may dictate that pollution control costs make further plant investment unwise, if not illogical.

Capital availability may be a much more serious problem for small plants which continue to operate primarily because owners have depreciated out original investment costs, or consider their investment in the plant as "sunk capital" and consequently of a "utility value" if continued in operation which is greater than the "market value" or "salvage value" of the plant should they decide to cease operations. For such plants, the increased investment required for pollution control may be difficult to obtain and, even if available, unattractive to both the borrower and the lender. In these situations, obtaining additional capital may reflect the owners' desire to maintain the business for personal employment reasons rather than to realize a return on invested capital.

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[1] Development Planning and Research Associates, Inc., "Initial Analysis of the Economic Impact of Water Pollution Control Costs Upon the Meat Industry," report to Environmental Protection Agency, November, 1972.

III. PRICE EFFECTS

Pricing Processes in the Meat Packing Industry

Price determination in the meat packing industry depends upon basic supply and demand conditions. In fact, the industry meets most of the criteria of competitive markets. Meat packers deal with large numbers of individual livestock producers, no one of whom can appreciably influence supplies or who can operate independently of present and future market conditions and anticipated prices. On the demand side, the meat packers sell to literally thousands of independent retail food outlets and supermarket chains. Although large food chains are an important factor in the retailing of meat and meat products, the food retailing industry is intensively competitive and the demand for meat is still dertermined in the marketplace by the demands of millions of customers. The meat packing industry also meets one other major test of competition--there are no artificial barriers to entry or exit in the industry. Although capital requirements are high, new firms do enter the industry, existing firms expand, contract, or close operations and the organization, structure and ownership of the industry changes over time. Concentration in meat packing declined markedly following World War II, as the percentage of total value of shipments accounted for by the four largest firms dropped from 41 percent in 1947 to 26 percent in 1967.

The sharp increases in meat prices during the first half of 1973 became of increasing concern to consumers and resulted in "meat boycotts" and other evidence of consumer resistance (Figure III-1). Reflecting their anxiety, consumers accused feeders, packers and meat retailers of forcing meat prices up when in fact strong consumer demand had been a major factor in those increases. Thus, changes in retail meat prices result from the interaction of a series of economic factors rather than from arbitrary decisions by farmers, meat packers, wholesalers and retailers.

The market conditions of 1973 were not anomalous. Generally, strong consumer demands have underlay retail meat price increases. This has been a major factor in boosting meat prices in recent years. Based on 1967 = 100, the index of retail meat prices rose to 153 in March, 1973. In spite of this substantial increase in prices, red meat consumption in 1973 remained near 190 pounds per capita, up 12 pounds from the 1967 consumption of 178 pounds. Although numerous factors do contribute to rising meat demand, the existence of increasing demand with increasing prices has primarily reflected steadily increasing per capita personal income. Indeed, numerous studies have demonstrated that a rising demand

Table III-1. Retail price, beef, pork and lamb, U.S. average, 1972-73[1]

Year and month		Retail price, cents per pound		
		Beef choice grade	Pork retail cuts & sausage	Lamb choice grade
1972	January	111.5	76.3	113.4
	February	115.8	81.3	115.1
	March	115.8	79.4	115.2
	April	112.0	78.2	115.6
	May	111.4	79.4	115.2
	June	113.5	82.0	118.4
	July	117.3	85.6	120.6
	August	115.8	86.0	120.7
	September	112.9	86.6	120.1
	October	112.8	87.5	120.5
	November	112.3	87.2	121.4
	December	114.6	88.5	124.3
1973	January	122.3	94.1	125.6
	February	130.3	97.1	131.3
	March	135.3	103.0	138.5
	April			

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[1] Source: Livestock and Meat Situation, ERS, USDA.

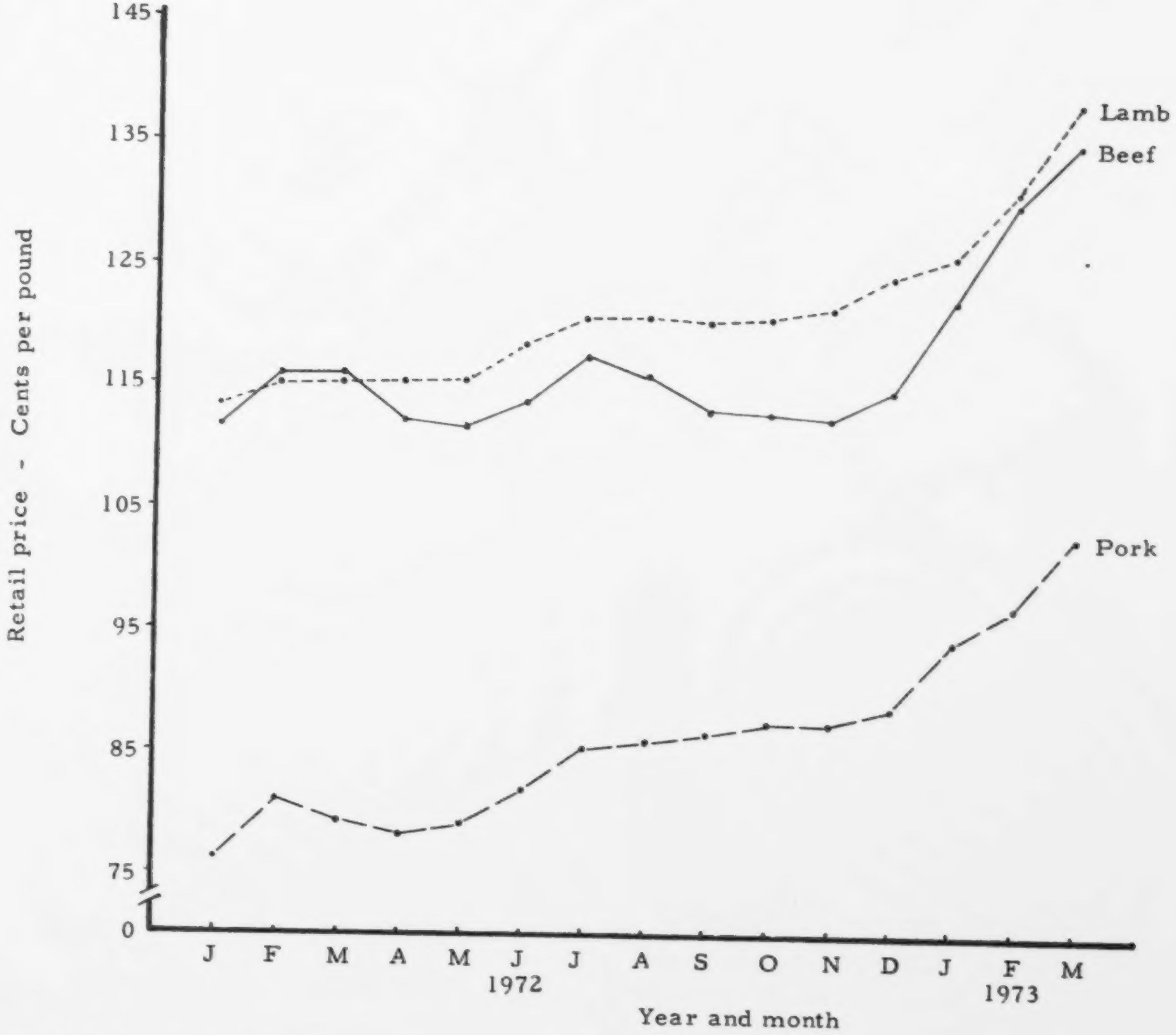

Figure III-1. Trend in retail meat prices for beef, pork and lamb, 1972-73.

for meat resulted from increases in per capita income. Certainly increasing per capita consumption of meat and continued population growth have combined to keep pressure on meat supplies during recent years.

Price-making in the Market

Although in the long-run, the price of meat is established by the interaction of consumer demand and the supply of available slaughter livestock, daily price offers and quotations for wholesale meats made by packers are based on the current wholesale meat price, the value of by-products, cold storage holdings of meats, and anticipated supplies and prices of slaughter livestock. Packers' offers for livestock are based on current wholesale meat and by-product prices, cold storage holdings of meats, and anticipated prices of livestock.

These pricing determinants result in a relatively constant relationship between live animal and wholesale meat prices (Figure III-2), and most of the occasional variations which do occur can be explained by current supply-demand conditions. Subject to production lags created by the marketing system, the supplies and prices of slaughter livestock show an inverse relationship and a consequent (Figure III-3) corresponding relationship between livestock supplies and meat prices. The cyclic periodicity evident in Figure III-3 results from the characteristic cattle and hog production cycles. The cattle cycle extends approximately ten years from peak to peak, and the hog cycle, four years.

Demand and Supply Response to Price Changes

The increased costs associated with the implementation of effluent control guidelines must be (1) absorbed by meat packers, (2) passed forward to consumers as higher meat prices, (3) passed backward to slaughter livestock producers in the form of lower prices for slaughter livestock, or (4) a combination of (1), (2) and (3).

Demand Factors -- Consumers' responses to increased meat prices will be conditioned by price elasticity (the measurement of the proportionate change in quantity caused by a proportionate change in price). Two other relationships also enter in: (1) income elasticity (the measure of the demand change related to disposable income fluctuation) and (2) cross-elasticity (the measure of the changes in demand associated with changes in price relationships among various types of meat or between meat and other close substitutes (poultry, eggs, cheese, etc.).

Elasticity coefficients for meat products are shown in Table III-2. In terms of price-elasticity (Section A, Table III-2), beef and pork are relatively inelastic (coefficient less than one) for changes in quantity taken are less than proportionate to changes in prices. However, the demand for lamb (coefficient -2.35) and veal (-1.60) are relatively elastic.

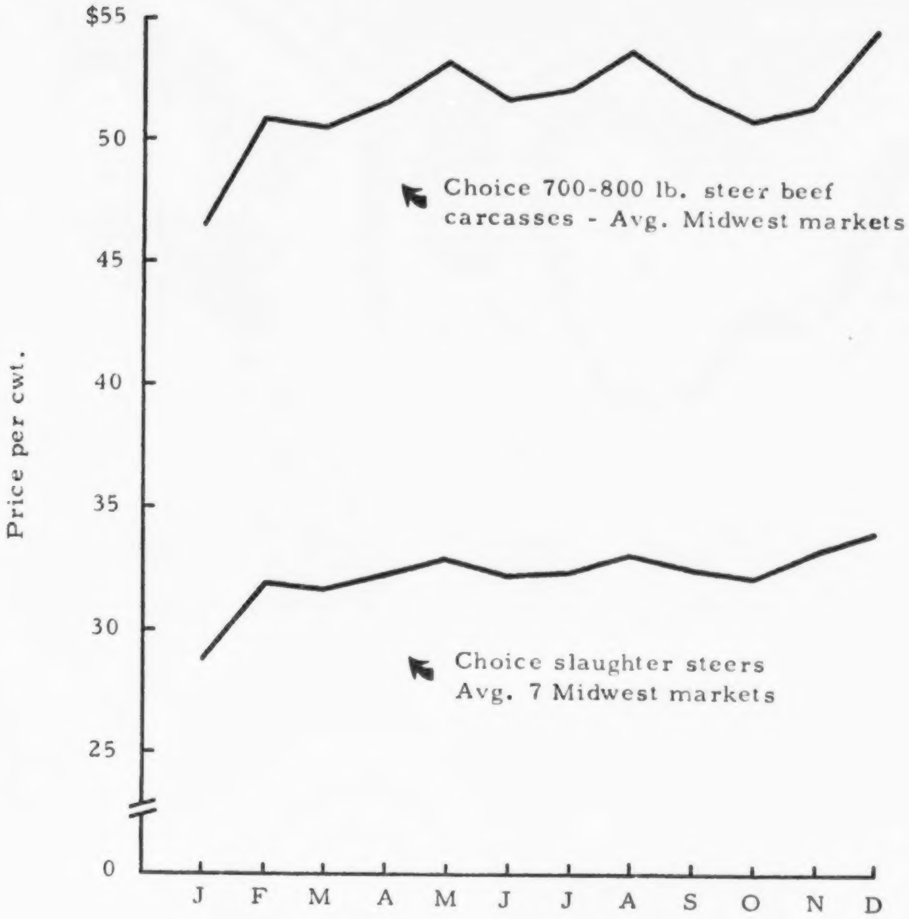

Figure III-2. Prices of choice steers and choice steer beef carcasses, Midwest markets, by months, 1971.

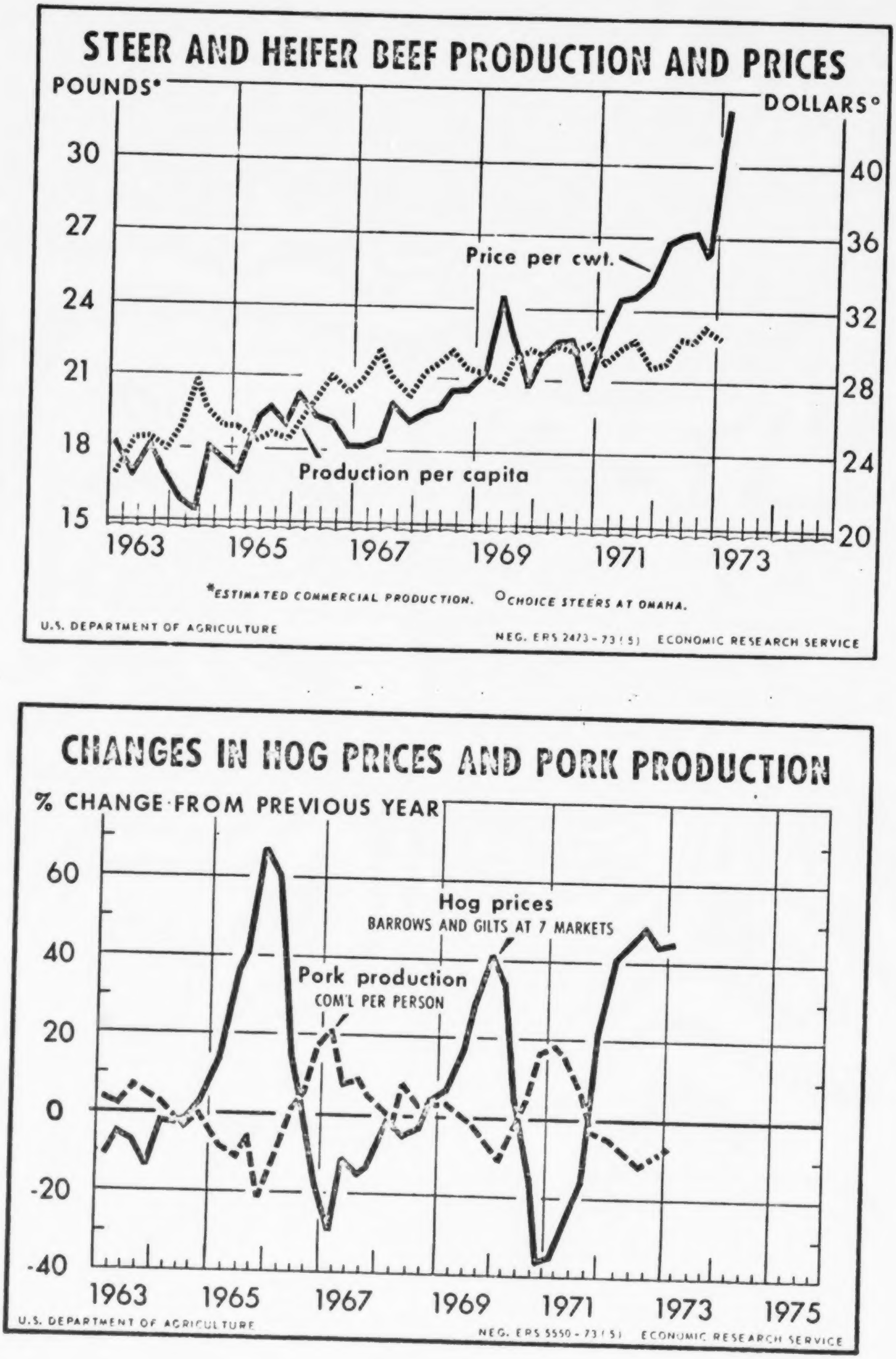

Figure III-3. Supply-price relationships, beef and pork production and prices.

Price-quantity relationships for meat products are further complicated by cross-elasticities (Section B). For example, the beef-pork coefficient shows that a one percent increase in the price of pork would be reflected by a 0.13 percent increase in the quantity of beef demanded--indicating a relatively low substitution rate between pork and beef.

Income elasticities for most meat products in the United States are positive, but less than one (Section C, Table III-2). For example, the beef income elasticity coefficient shown indicates that a one percent rise in per capita income will be associated with a 0.47 percent increase in per capita consumption of beef. The income elasticity of demand for pork is lower than that for other meat products.

Supply Factors -- The effects on hog and cattle production of changes in slaughter livestock prices are more complex than those involving demand responses and price changes. The key price factor affecting the volume of hog production is the hog-feed price ratio, not the hog price directly. Two price ratios influence cattle production response--the cattle-feed price ratio and the feeder cattle-fed cattle price ratio. As would be expected, favorable price ratios induce increased production while disadvantageous price ratios result in reduced production. However, the supply responses take time--about two years for hogs and five years for fed cattle. Empirical research concerned with livestock price-supply response indicates supply elasticities of about 0.50 to 0.75, ratios which imply that the adjustment in fed livestock supplies to a one percent change in price is about 0.50 to 0.75 percent in the same direction.

Likelihood of Price Changes

Potential price impacts resulting from the imposition of stricter water pollution standards on the meat packing industry are higher retail prices, lower farm prices for livestock, lower profits for processors, with resultant lower meat production and consumption. Because the meat packing industry characteristically has low profit margins, the additional costs will tend to be passed on to the consumer. The relative amount to be so passed on depends upon the extent to which lower-cost meat processing techniques develop to allow the efficient firms to offset this pollution abatement cost and to force lower returns in the higher cost plants through market competition. With no dramatic change in meat packing techniques predicted, apparently packers cannot absorb this added cost.

Table III-2. Elasticity coefficients for meat products[1/]

Elasticity measurement	Product	Coefficient
A. Price-elasticity	Beef	- .95
	Veal	-1.60
	Pork	- .75
	Lamb	-2.35
	Chicken	-1.16
	Fish	- .65
B. Cross-elasticity	Beef-veal	.38
	Beef-pork	.13
	Beef-lamb	.62
	Beef-chicken	.23
	Beef-fish	.02
	Pork-beef	.10
	Pork-veal	.19
	Pork-lamb	.41
	Pork-chicken	.16
	Pork-fish	.02
C. Income-elasticity	Beef	.47
	Veal	.58
	Pork	.32
	Lamb	.65
	Chicken	.37
	Fish	.42

[1/] Source: Brandow, G. E., "Interrelations Among Demands for Farm Products and Implications for Control of Market Supply," Penn. Agr. Exp. Sta. Bull. 680.

Figure III-4 indicates market response to increasing packing costs. D_r is the aggregate demand curve for red meats at the retail level. D_f is the derived demand curve for red meats at farm level. This curve is obtained from the relationship between farm price and retail price. George and King [1/] found the following price relationships based upon quarterly data:

$$P^{farm}_{beef} = -24.52 + 0.9188 \, P^{retail}_{beef} \qquad R^2 = .75$$

$$P^{farm}_{pork} = -21.58 + 0.9014 \, P^{retail}_{pork} \qquad R^2 = .90$$

$$P^{farm}_{lamb} = -21.50 + 0.8447 \, P^{farm}_{lamb} \qquad R^2 = .76$$

Stronger relationships were not found because farm-retail price margins do not concurrently follow farm prices during the hog cycle and beef cycle. Price spreads tend to narrow during the upturn in prices because retail price increases lag behind farm price increases. Conversely, when farm prices decline, price spreads increase. Beef price spread is $P_{retail} - P_{retail} + 24.52 - 0.9188 \, P_{retail}$. Price spread $= 24.52 + 0.0812 \, P_{retail}$ Plotting the price spread on Figure III-5 gives the derived demand for beef at farm levels. The farm level supply of meats is determined by the sizes of breeding herds. The long run supply curve (S) reflecting farmers' reaction in the long run to changing farm prices for livestock is also shown.

With the imposition of stricter effluent standards, processor costs will increase and will be passed on by the wholesaler and retailer to the consumer. This additional cost increases the price spread between farm and retail by a \$ per unit, and consequently will decrease derived demand points at farm levels by that amount to D'_f. Prior to the new standards, long-run prices and quantity were P_r, P_f and q. The new equilibrium is reached when farm level demand and supply are at the market clearing price P_f'. The costs which were not absorbed by the processor resulted in (1) an increase in retail beef price from P_r to P_r' and (2) a decrease in

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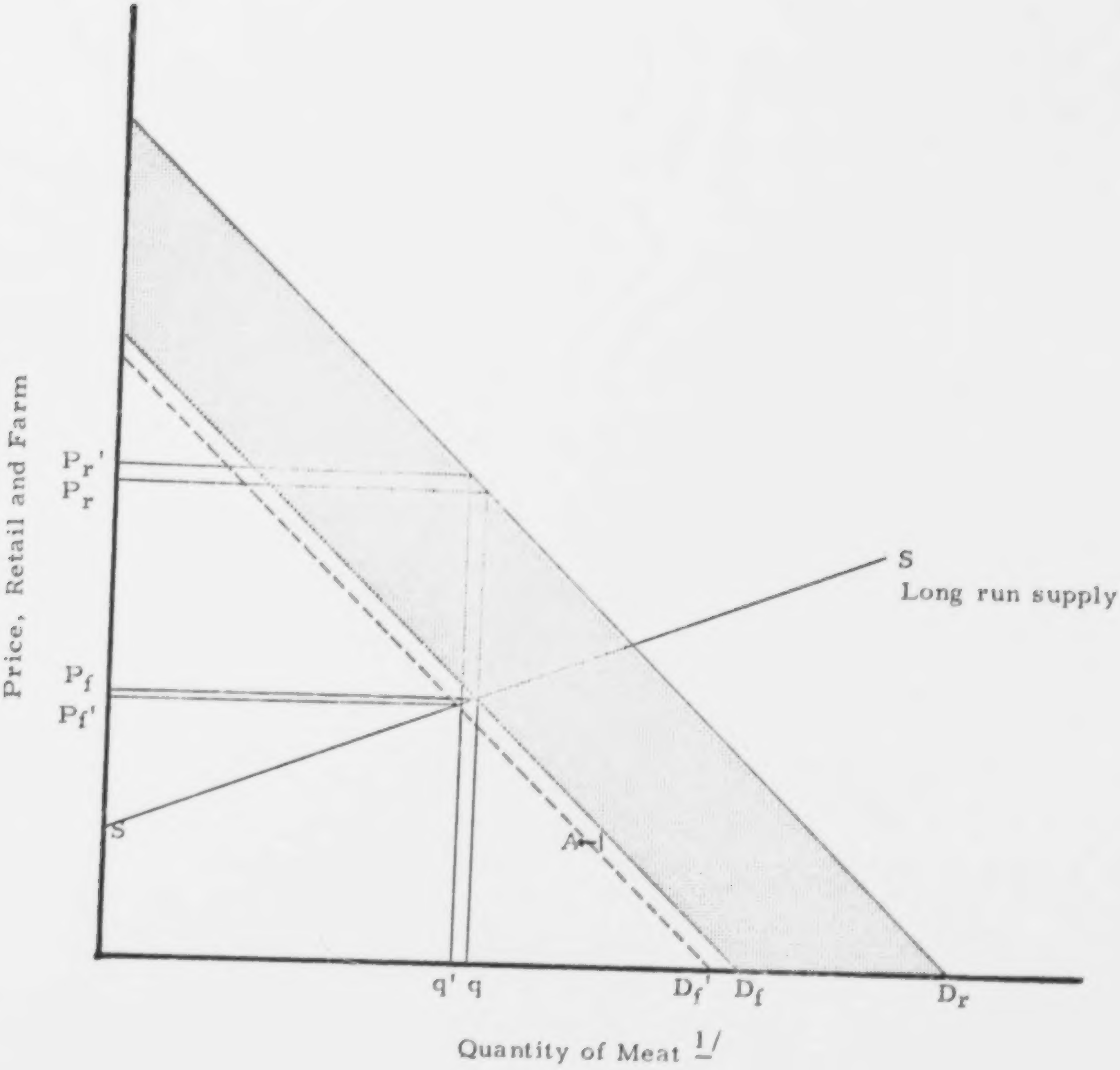
[1/] George, P. S. and G. A. King, "Consumer Demand for Food Commodities in the United States with Projections for 1980," University of California, Gianinni Foundation Monograph Number 26, March, 1971.



1/ Farm level quantity based on retail cut equivalent, equal to live weight quantity times percent retail cut out of live animal.

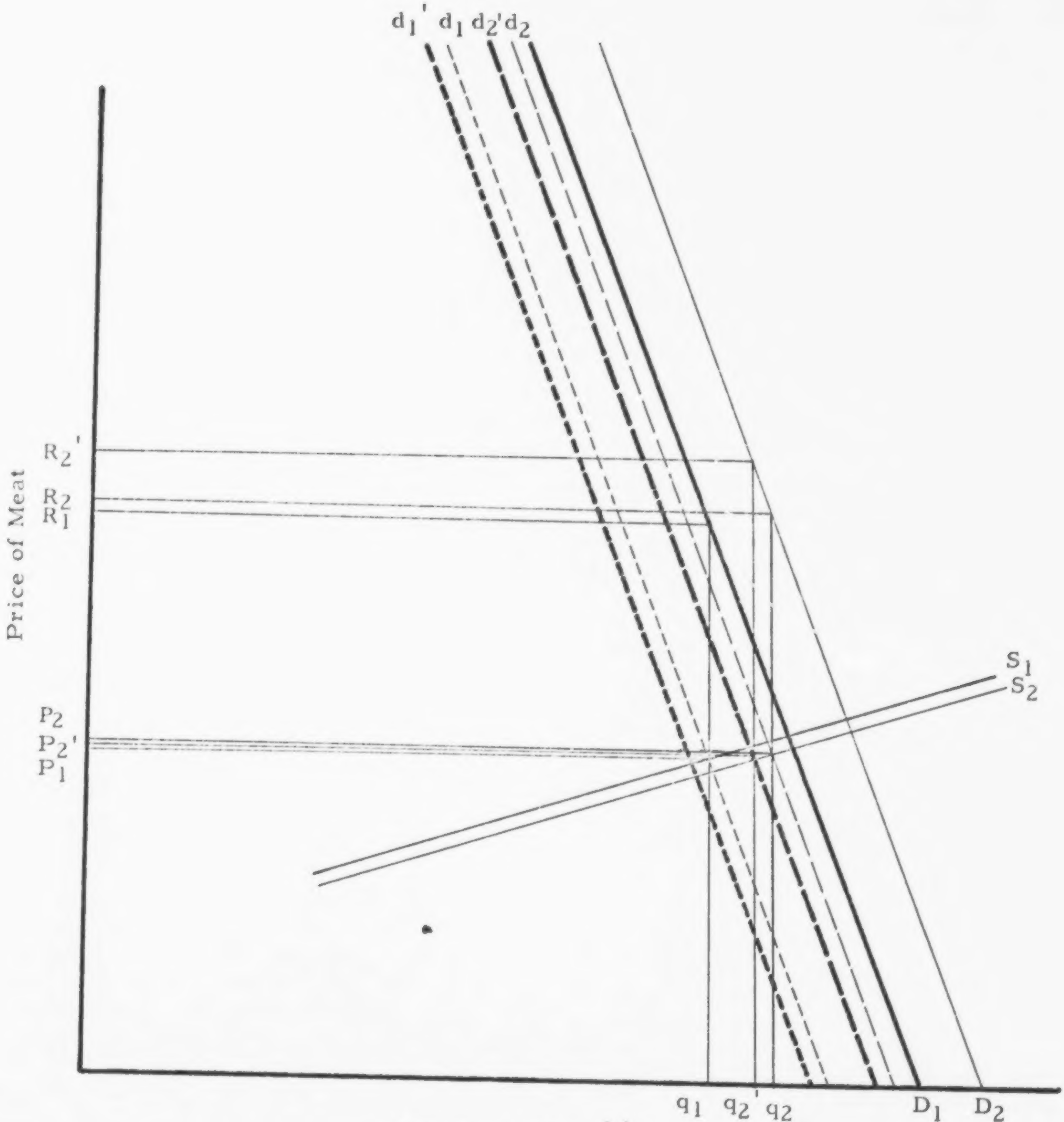
Figure III-4. Impact of increased processing costs.

quantity consumed from q to q' and (3) a reduction in farm price to P_f'. The relative impact on farm and retail prices is determined by the elasticity of supply and elasticity of demand. With a more inelastic supply, the price impact is heavier on farmers and is conversely, highly inelastic in the short-run. Then the price impact will be heaviest on the livestock producers. As livestock producers reduce supply in response to this price decline, the cost will be shifted from the farmer to the consumer in the form of higher prices at both farm and retail levels. With supply elastic in the long-run, most of, but not all, the cost will be shifted to the consumer. The difference between P_f and P_f' in the long-run case is the price impact on livestock producers.

In instances where industry demand and supply are shifting, the effects illustrated in the stable situation will be present though perhaps not apparent. Figure III-5 illustrates the case of expanding demand and supply. Retail demand shifts from D_1 to D_2 in going from period 1 to period 2. Supply likewise shifts from S_1 to S_2. The derived demands associated with the retail demand curves are d_1 and d_2 prior to the imposition of stricter water quality standards. Following the imposition, they are d_1 and d_2, respectively.

In period one, prior to new standards, quantity, q, is given by the intersection of d_1 and S_1. The retail price is R_1, and the farm price is P_1. With no change in standards, the diagram depicts increasing supply and demand and increasing prices which result from demand shifting faster than supply. Retail price is R_2, farm price is P_2, and quantity is q_2.

Now assume that the new standards are imposed between period 1 and per period 2. In going from period 1 to period 2, the derived demand curve shifts from d_1 to d'_2. Farm price, P'_2 is slightly lower than P_2, with no new standards, but is higher than the previous period's price. The retail price rises above the price in the no new standards case. In this situation, where demand is increasing faster than supply, the imposition of new water quality standards resulted in both higher consumer prices, as expected, and increased output and farm prices because the shift in demand more than offset the impact of the standards (d'_2 is to the right of d_1). Thus, the shifting of costs to the consumer depends upon the rate at which the market situation is changing. During 1972 and 1973, consumer demand for meat, stimulated by rising consumer incomes, outpaced increases in livestock supplies, and resulted in rapidly rising livestock and meat prices. Under similar conditions and in the absence of price controls, cost increases associated with water pollution controls would be passed on primarily to the consumer in the form of higher meat prices.


d1'
d1
d2'
d2
R2'
R2
R1
Price of Meat
P2
P2'
P1
S1
S2
q1
q2'
q2
D1
D2
Quantity of Meat 1/

1/ Farm level quantity based on retail cut equivalent, equal to live weight quantity times percent retail cut out of live animal.

Figure III-5. Impact or price of increased processing costs during industry expansion.

IV. ECONOMIC IMPACT ANALYSIS METHODOLOGY

The economic impact analysis utilizes the basic industry information developed in Chapters I-III and that concerning pollution abatement technology and costs provided by the Environmental Protection Agency. The impacts examined include:

Price effects
Financial effects
Production effects
Employment effects
Community effects
Other effects

The determining force of plant shutdowns on these impacts is crucial; consequently, the Financial and Production effects, those which most immediately reflect plant shutdowns, will receive most emphasis in this financial and plant closure analysis.

In general, the impact analysis methodology is the same as that normally used in feasibility capital budgeting studies of new investments. Simply stated, the problem is one of deciding whether a commitment of time or money to a project is worthwhile in terms of the expected benefits derived. The decision in this case is complicated by the fact that benefits will accrue over a period of time and that in actuality no analyst is sufficiently clairvoyant or physically able to reflect upon all of the required cost and benefit analysis information which by definition must deal with projections of the future. In the face of imperfect, incomplete information and time constraints, the industry segments were reduced to money relationships insofar as possible and the key non-quantifiable factors were incorporated into the analysis to modify the quantified data. The latter process is particularly important in view of the use of model plants in the financial analysis. In practice, actual plants will differ from the model, and these differences must necessarily be considered in any interpretation of analytic data reflecting the behavior of model plants.

Fundamental Methodology

Much of the underlying analysis regarding price, financial, and production effects is applicable to all other impact effects. Consequently, the case methodology described here is conceptually integrated and the specific impact interpretations are discussed under their appropriate headings.

The core conceptual data used in this analysis are the physical and financial characteristics of the various industry segments as projected on the basis of model plants. The estimated cash flows for these model plants are summarized in Chapter II.

The primary factors involved in assessing the financial and production impact of pollution control are profitability changes and these, in turn, are a function of the cost of pollution control and the ability to pass along these costs in higher prices. In reality, of course, closure decisions are seldom made on the basis of well defined common economic rules; such decisions invariably include a wide range of personal values, external forces such as the ability to obtain financing, or the role of the production unit in an integrated larger cost center.

Such variables include but are not limited to the following conditions and are generally characteristic of proprietorships and closely held enterprises rather than publically held corporations.

1. Production units may lack sufficient financial accounting data. This is especially likely to occur among small, independent operators who do not have effective cost accounting systems.

2. Production units may be so old and fully depreciated that management has no intention of replacing or modernizing them. Production continues only so long as it covers labor and materials costs and/or until the equipment becomes inoperative.

3. Marginally productive units may be acquired by new ownership that can reevaluate existing assets or that can absorb temporary low returns with the expectation of eventual acceptable profit returns.

4. Production unit ownership may have value as psychic income. Such ownership, that is, may answer personal values that are great enough to override rational economic decisions.

5. The production unit, if part of a larger economic entity, may (1) use raw materials produced in another plant within the firm that must have an assured market or (2) supply raw materials to another unit within the firm. When the profitability of the second operation offsets

the losses in the first plant, the unprofitable operation may continue indefinitely because the total enterprise is profitable.

6. The owner-operator expects that adverse conditions and consequent losses are temporary. His ability to absorb short-term losses depends upon his access to funds through credit or personal resources not presently utilized.

7. There are very low (approaching zero) opportunity costs for the fixed assets and for the owner-operator's managerial skills and/or labor. As long as the operator can meet labor and materials costs, he will continue to operate. He may even operate with gross revenues below variable costs until he has exhausted his working capital and credit.

8. Production units may also continue to function if the value of the land on which the plant is located is appreciating at a rate sufficient to offset short-term losses, funds are available to meet operating needs, and opportunity costs of the owner-operator's managerial skills are low.

While the above variable factors are frequently relevant to business decisions, economic rules are commonly universal. Thus, to provide as useful and reliable an insight into potential business responses to new investment decisions involving pollution control facilities, economic analysis will be used as the core analytical procedure. Given known pricing conditions, the impact of pollution control costs and resulting prices on profitability can be determined by employing the ROI (or any other) profitability measure under conditions of the new price and incremental investment in pollution control. The primary consequence of profitability changes is the impact on the plant regarding plant shutdown rather than making the required investment in meeting pollution control requirements.

In the most fundamental case, a plant will close when variable expenses (Vc) are greater than revenues (R). However, in practice plants may continue to operate where $Vc > R$ under such conditions as:

* a lack of cost accounting detail to determine when $Vc > R$,

* the opportunity cost of labor or other resource is less than market values (This would be possible in a proprietorship whose owner considers his labor as fixed.),

- other personal and external financial factors exist, or
- there are expectations that revenues will shortly increase to cover variable expenses.

A more probable situation is the case in which $Vc < R$ but revenues are less than variable costs plus fixed, short-run cash overhead expenses (TCc). In this situation a plant would likely continue to operate as contributions are being made toward covering a portion of these fixed cash overhead expenses. The firm cannot operate indefinitely under this condition, but the length of this period is uncertain. Necessary to such a situation is the firm's expectation that revenues will increase to cover cash outlay. The conditions affecting closure decisions in such cases include:

- the extent of capital resources (If the owner has other business interests or debt sources that will supply capital input, the plant will continue.),
- there are not adequate cost accounting details or procedures to know that $TCc > R$ (particularly in multiplant or business situation), or
- labor or other resources are considered fixed and the opportunity cost for these items is less than market value.

The identification of plants where $TCc > R$, but $Vc < R$ leads to an estimate of plants that should eventually close if revenues do not increase. The timing of such closures, however, is difficult to predict.

The next level of analysis, where $TCc < R$, involves estimating the earnings before and after investment in pollution abatement. Under conditions in which $TCc < R$, it seems likely that investment in pollution control will be made and that plant operations will continue so long as the capitalized value of earnings (CV) (at the firm's cost of capital) is greater than the scrap or salvage value (S) of the sunk plant investment. If $S > CV$, the firm could realize S in cash and reinvest and be financially better off. This presumes reinvesting at least at the firm's (industry's) cost of capital.

Computation of CV involves discounting the future earnings flow to present worth through the general discounting function:

$$V = \sum_{n=1}^{t} A_n (1+i)^{-n}$$

where

V = present value
A_n = a future value in n^{th} year
i = discount rate as target ROI rate
n = number of conversion products, i.e., 1 year, 2 years, etc.

It should be noted that a more common measure of rate of return is the book rate, the rate which measures after-tax profits as a ratio of invested capital. These ratios should not be viewed as a different estimate of profitability as opposed to DCF measures (discounted cash flow); they reflectan entirely different profitability concept. The reader is cautioned not to compare the DCF rates directly with book rates. Although both measures will be reported in the analyses, the book rate is reported for informational purposes only.

The two primary types of DCF measures of profitability are used. The first is the internal rate of return or yield, and it is the computed discount rate (yield) which produces a zero present value of the cash flow. The yield is the highest rate of interest the investor could pay if all funds were borrowed and the loan were returned from the cash proceeds of the investment. The second DCF measure is the net present value concept. Rather than solve for the yield, a discount rate equivalent to the firm's cost of capital is used. Independent investments with net present values of above zero are accepted; those below zero are rejected. The concept of comparing capitalized earnings with the sunk investment value is a variation of the net present value method.

The data input requirements for book and DCF measures are derived, to a large extent, from the same basic information although the final inputs are handled differently for each.

Benefits

In this analysis, benefits for the book analysis have been called after-tax income; and for the DCF analysis they are called after-tax cash proceeds. The computation of each is shown below:

$$\text{After tax income} = (1 - T) \times (R - E - I - D)$$

$$\text{After tax cash proceeds} = (1 - T) \times (R - E - D) + D$$

where

T = tax rate

R = revenues

E = expenses other than depreciation and interest

I = = interest expense

D = depreciation charges

Interest is omitted in the cash proceeds computation since it is reflected in the discount rate, the after-tax cost of capital (see below). Depreciation is included in the DCF measure only in terms of its tax effect and is then added back so that a cash flow over time is obtained.

A tax rate of 48 percent was used throughout the analysis. Accelerated depreciation methods, investment credits, and carry forward and carry back provisions were not used due to their complexity and special limitations. Obviously, in some instances the effective tax rate may be lower in a single plant situation, but with the dominance of multiplant firms, the firm's tax rate will be close to the 48 percent rate.

The revenue, expense, interest and depreciation charges used were those discussed in Chapter II and Chapter V for pollution control facilities. These were assumed to be constant over the period of analysis.

Investment

Although investment is normally thought of as outlays for fixed assets and working capital, in evaluating the closure potentiality of an on-going plant where the basic investment is sunk, the value of that investment must be made in terms of its liquidation or salvage value, that is in its opportunity cost or shadow price. [1] For purposes of this analysis, sunk investment was taken as the sum of equipment salvage value plus land at current market value plus the value of the plant's net working capital (current assets less current liabilities, see Chapter II for values). This amount was taken as a negative investment in the terminal year. Replacement investment for plant maintenance was considered to be equal to annual depreciation, a procedure which corresponds to the operating policies of some managements and which serves as a good proxy for replacement in an on-going business.

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[1] This should not be confused with a simple buy-sell situation which merely involves a transfer of ownership from one firm to another. In this instance, the opportunity cost (shadow price) of the investment may be different.

Investments in pollution control facilities are the estimates provided by EPA and shown in Chapter V. Only incremental values were used.

The above discussion refers primarily to the DCF analysis. Investment for estimating book rates was taken as invested capital, as the book value of assets plus net working capital. In the case of new investment, its book rate was estimated as 50 percent of the original value.

Cost of Capital - After Tax

Return on invested capital is a fundamental notion in U. S. business. It provides both a measure of a firm's actual performance as well as its expected performance. In the latter case, it is also called the cost of capital. In this analysis the cost of capital is defined as the weighted average of the cost of each type of capital employed by the firm, generally its equities and interest bearing liabilities. There is no methodology that yields the precise cost of capital, but the cost can be approximated within reasonable bounds.

The cost of equities was estimated by two methods--the dividend yield method and the earnings stock price (E/P ratio) method. Both are simplifications of the more complex DCF methodology. The dividend method is:

$$k = \frac{D}{P} + g$$

where

k = cost of capital
D = dividend yield
P = stock price
g = growth

The E/P method is simply

$$k = E/P$$

where

E = earnings
P = stock price

and is a further simplication of the first. The latter assumes future earnings as a level, perpetual stream.

The after tax cost of debt capital was estimated by using an estimated 7.5 percent cost of debt and multiplying it by .52 -- assuming a 48 percent tax rate. These values were weighted by the respective equity to total asset and total liabilities [1] to total asset ratios.

The average cost of capital for the meat packing industry was estimated as follows and was based on various Standard & Poor's industry surveys:

Dividend Yield Plus Growth Method

Capital	Weight	Cost	Growth	Cost
Equity	.61	.026	.04	.041
Debt	.39	.039	--	.015
Average cost of capital				.056
E/P Method				
Equity	.61	.085	--	.052
Debt	.39	.039	--	.015
Average cost of capital				.067

As shown in the above computations, the estimated after-tax cost is 5.6 to 6.7 percent. The subsequent analysis was based on 6.0 percent. The four percent growth factor is roughly equal to inflation expectations.

It was assumed that, for the meat packing industry, a pre-tax cost of capital of 11.5 percent was valid for evaluating new projects.

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[1] It is recognized that liabilities contain non-interest bearing liabilities, but its weight is believed to be an adequate proxy for the weight of debt.

Construction of the Cash Flow

A thirty - two period cash flow was used in this analysis and was constructed as follows:

1. Sunk investment (salvage market value of fixed assets plus net working capital) taken in year t_o.
2. After tax cash proceeds taken for years t_1 to t_{30}.
3. Annual replacement investment, equal to annual current depreciation taken for years t_1 to t_{30}.
4. Terminal value equal to sunk investment taken in year t_{31}.
5. Incremental pollution control investment taken in year t_o for 1977 standards and year t_6 for 1983 standards.
6. Incremental pollution expenses taken for years t_1 to t_{30} for 1977 standards and years t_7 to t_{30} for 1983 standards.
7. No replacement investment taken on baseline pollution investment on assumption of 30-year useful life.
8. Replacement investment taken on Level I incremental investment in year 25 and on Level II incremental investment in year 21 based on useful lives of 25 and 15 years, respectively.
9. Terminal value of pollution facilities equal to 10 percent of original cost taken in year t_{31}.

Price Effects

At the outset, it must be recognized that price effects and production effects are so interrelated that each has an associated impact upon the other. In fact, the very basis of price analysis is the premise that prices and supplies (production) are functionally related variables which are simultaneously resolved.

The determination of price effects requires a knowledge of demand growth, price and supply elasticities, the extent of regional market influence, the degree of large firm dominance in the industry, the market concentration of the industry's suppliers of inputs and purchasers of outputs, the organization of and coordination within the industry, the relationship between domestic output and the world market, the existence and nature of complementary goods, the industry's cyclical trends, the current utilization of the industry's capacity, and the effect of exogenous influences that bear upon price determination (e. g., governmental regulation).

In view of this complex diversity of factors involved in determining the market price, a purely quantitative approach to the problem of price effects is not feasible; hence, the simultaneous considerations suggested above have been made. The judgment factor was heavily employed in determining the supply response to a price change and the alternative price changes to be employed.

In order to provide a standard which would reflect price effects, this study computed an estimated price sufficient to insure plant profit stability. The required price increase at the firm level was evaluated in light of the relationship of the model plant to the industry and to the competitibe characteristic of the industry. The required price increase was computed by the described DCF analysis. It dealt only with incremental pollution investment and cash proceeds.

The application of the above DCF procedure to these costs yielded the present value of pollution control costs (i.e., investment plus operating cost less tax savings). Wherever this is known, the price increase required to pay for pollution control can readily be calculated by the formula

$$X = \frac{(PVP)(100)}{(1-T)(PVR)}$$

where:

X = required percentage increase in price

PVP = present value of pollution control costs

PVR = present value of gross revenue starting in the year pollution control is imposed

Note that this formula implies that incremental profits resulting from the price increase was taxed at a rate of 48 percent.

Financial Effects

In Chapter II, the financial characteristics of model plants were presented. These data served as the base point for the analysis of the financial effects of pollution control. The primary focus of the analysis was upon profitability in the industry and the ability of the firms to secure external capital. Obvious, then, this portion of the analysis cannot be divorced from production effects since profit levels and a firm's to finance pollution abatement facilities will have a direct influence on supply responses--on utilization of capacity and plant closures.

To measure profitability the analysis employed after-tax book rate of return on invested capital and cash flow (after-tax profit plus depreciation) measurements. After-tax profit as a percent of sales was reported in order to compare financial data with standard industrial measures.

In addition to these factors, two additional measures of economic profitability were also examined: (1) capitalized value of earnings and (2) present values estimated by the procedures described in Section A above. Both of these measures were calculated on pre- and post-pollution control bases.

Given these financial measurements, the ability of the industry to finance the required pollution control expenditures was reexamined in light of the financial results and the information shown in Chapter II. The ability to do this varies from one industry subsector to another due to differential financial structures, profitability and abatement requirements; hence, capital availability and cost had to be examined on a model plant by model plant basis.

Production Effects

The potential production effects of the imposition of pollution controls include reductions of capacity utilization rates, plant closures and industry stagnation. Reductions in capacity utilization were estimated via qualitative techniques based upon the analysts' knowledge of the industry. The same was true for assessing the extent to which plant closures may be offset by increases in capacity utilization on the part of operating plants. Data limitations and time constraints required that the impact of pollution control standards upon future growth of the industry also be estimated via qualitative methods.

The remaining effect, plant closures, was difficult to measure realistically as discussed above in Section A. As a starting point in the plant closure analysis, a shutdown model was employed to indicate which model plants should close, which would function as marginal operations and which as sound. These conclusions assumed that a plant would close when its net present cash flow value is less than zero.

The analysis recognized that model plants are theoretical and cannot project all relevant factors; thus, for any given model plant one would expect to find some actual plants with profits lower and some higher than shown for the model plant. One can describe this phenomenon statistically via distribution functions. By examining Dun and Bradstreet, Inc. publications, we would estimate if normality is assumed, that the industry-wide standard deviation of net profit as a percent of sales at 1.0. However, the industry-wide distribution skewed to the right because a large portion of the industry is composed of packinghouses which generally show higher than median profits. If one were to segment the industry and estimate the distribution for each size category in each segment, the results would closely approximate normality.

For the purpose of analyzing financial and plant closure effects, the distribution of net present value (discounted) as a percent of sales was examined. It was assumed that this distribution was normal for each of the model plants. As a starting point it was noted that the 1.0 standard deviation of net profits as a percent of sales would equal 13.8 percent if multiplied by the 6 percent annuity factor for 30 years. Of course, annual profits for an actual plant vary temporarily primarily because of plant type and size variations.

Defining the median for the distribution as the model plant's net present value (assuming primary effluent treatment) divided by animal sales and, then by utilizing published data and data in the contractor's files, the standard deviation of net present value divided by sales was estimated as 0.3 times the median. This methodology implies that the model plant represents the median plant for the distribution and that there will be a different standard deviation associated with each model plant. The procedure further implies that the standard deviation is larger for the more profitable industry segments. By utilizing the net present values calculated under alternative effluent treatment assumptions, the standard deviations described above and the assumption that plants with a negative ratio for net present value divided by sales will be forced to close, the percentage of firms closing in each industry segment can be readily estimated through accepted statistical techniques.

Employment Effects

Given the production effects of estimated production curtailments, plant closings and changes in industry growth, one recognizes that these factors affect industry employment. The employment effects stemming from each of these production impacts were estimated. The the extent possible, the major employee classifications involved were examined as was the potential for re-employment.

Community Effects

Although the direct impacts of job losses upon a community are immediately apparent, in many cases, plant closures and cutbacks have a far greater impact than just that of employment loss. Multiplier effects may result in even more unemployment. Badly needed taxes for vital community services may dwindle. Community pride and spirit may be dampened. However, in some cases, the negative community aspects of production effects may be short-term and relatively minor within the overall community. In a few cases, the closure of a plant may actually be viewed as a positive net community effect (e.g., a small plant with a high effluent load in an area with a labor shortage).

These impact factors were qualitatively analyzed as appropriate.

Other Effects

Other impacts such as direct balance of payments effects were also qualitatively analyzed.

V. EFFLUENT CONTROL COSTS

Water pollution control costs used in this analysis were furnished by the Effluent Guidelines Division of the Environmental Protection Agency [1] and were adapted to the types and sizes of slaughter plants and packinghouses specified in this analysis.

Three effluent guideline requirements were considered:

BPT - Best Pollution Control Technology Currently Available (to be achieved by July 1, 1977)

BAT - Best Available Pollution Control Technology Economically Achievable (to be achieved by July 1, 1983)

NSPS - New Source Performance Standards, apply to any source for which construction starts after the publication of the proposed regulations for the Standards

A technical document entitled "Meat Products Point Source Category - Proposed Effluent Limitation Guidelines for Existing Sources and Standards for New Sources" describing the recommended technology for achieving the three guidelines has been published by EPA in the Federal Register (October 29, 1973). To avoid duplication and possible confusion, no technical descriptions of BPT, BAT and NSPS guidelines are given in the present report. The interested reader is referred to EPA's technical document for technology descriptions.

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[1] Development Document for Proposed Effluent Limitations Guidelines and New Source Performance Standards for the Red Meat Processing Segment of the Meat Products Point Source Category," Environmental Protection Agency, June, 1973.

EPA provided effluent treatment costs for four "typical" plants:

1. "Simple" slaughterhouse - kills 484,000 pounds liveweight basis per day. Does a very limited amount of processing of by-products (i.e., secondary processing). Usually, no more than two secondary processes, such as rendering, paunch and viscera handling, blood processing or hide or hair processing are carried out.

2. "Complex" slaughterhouse - kills 1,310,000 pounds liveweight basis daily. Does extensive processing of by-products (i.e., secondary processing). It usually carries out at least three of the secondary processes listed above.

3. "Low-processing" packinghouse - kills 900,000 pounds liveweight basis daily. Normally processes less than the total animals killed at the site but may process up to the total killed.

4. "High-processing" packinghouse - kills 800,000 pounds liveweight basis daily. Normally processes both the total kill at the site and additional carcasses from outside sources.

Baseline Effluent Control Costs

Effluent control costs for each of the three treatment levels were based upon an assumption that baseline pre-BPT treatment included in-place systems for removal of settleable solids and grease plus anaerobic and aerobic lagoons. Baseline costs for this assumed existing treatment system are shown in Table V-3.

Incremental Effluent Control Costs

Given the baseline effluent control costs shown in Table V-3, which were assumed to be in place for the "typical" plants specified, estimates were given for the incremental costs required to achieve effluent controls adequate to meet BPT and BAT guidelines for the four "typical" plants (Table V-4). Costs for meeting NSPS guidelines were assumed to equal BPT costs until 1983 at which time they will actually equal BAT costs.

Table V-3. Baseline effluent control costs for "typical" types of slaughterhouses and meat packinghouses, 1971 costs

Cost Item	Simple slaughterhouse 121 mill lbs. lwk.	Simple slaughterhouse 328 mill. lbs. lwk.	Low-process packinghouse 225 mill. lbs. lwk.	High-process packinghouse 200 mill. lbs. lwk.
Investment	$238,000	$425,000	$400,000	$475,000
Annual Cost	53,300	85,600	80,700	93,500
Capital	23,800	42,500	40,000	47,500
Depreciation	8,800	15,300	14,500	16,900
Operating cost	20,700	27,800	26,200	29,100

Source: "Development Document for Proposed Effluent Limitation Guidelines and New Source Performance Standards for the Red Meat Processing Segment of the Meat Products Point Source Category," Environmental Protection Agency, June, 1973.

Table V-4. Incremental effluent control costs for "typical" types of slaughterhouses and meat packinghouses, 1971 costs

Effluent control level	Cost Item	Simple slaughterhouse 121 mill. lbs. lwk.	Complex slaughterhouse 328 mill. lbs. lwk.	Low-process packinghouse 225 mill. lbs. lwk.	High-Proces packinghouse 200 mill. lbs. lw
BPT	Investment	$80,000	$139,000	$131,000	$148,000
	Annual Cost	19,360	39,360	33,750	42,000
	Capital	8,000	13,900	13,100	14,800
	Depreciation	3,200	5,560	5,240	5,920
	Operating Cost	8,160	19,900	15,410	21,280
BAT	Investment	425,000	665,000	629,000	736,000
	Annual Cost	160,930	285,360	249,750	306,000
	Capital	42,500	66,500	62,900	73,600
	Depreciation	27,800	42,660	39,940	47,620
	Operating Cost	90,630	176,200	146,910	184,780
NSPS	Same as BPT - The effluent treatment costs for new sources is assumed to be the same as that for the Best Practicable Control Technology Currently Available.				

Source: "Development Document for Proposed Effluent Limitation Guidelines and New Source Performance Standards for the Red Meat Processing Segment of the Meat Products Point Source Category," Environmental Protection Agency, June, 1973.

Modified Costs - Effluent Control Systems

The effluent control costs provided by EPA were "single point" estimates which applied specifically to a given type of plant with a given annual liveweight kill volume. Obviously, effluent treatment costs vary with wasteflow and, hence, processing volume. Based on discussions with EPA and North Star Research Institute personnel, DPRA estimated investment and annual treatment cost data for alternative plant sizes. These estimates assumed that, for a given treatment level, both investment and operating costs were a function of wasteflow quantity. Given that assumption, each of the four "typical" plants were plotted on a graph and a smooth curve was drawn to "fit" the points. Although the points representing the "typical" plants did not fall precisely on the line, the fit is acceptable. It is of importance, however, that the four "typical" plants, specified in the technical report, all had wasteflows exceeding 0.3 million gallons per day while four of DPRA's model plants have flows of less than 0.2 million gallons per day. The extrapolations required to estimate costs for those plants added to the possible analytical error in the analysis of small plants.

Having developed baseline and incremental treatment costs for BPT and BAT controls, these costs were added to get "total" control costs.

Since the cost data provided to DPRA were based on 1971 costs, they were updated to 1972 levels by using appropriate inflators (i.e., Index of Sewage Treatment Plant Construction Cost for investment; and the Implicit Price Inflator for GNP for operating costs).

The cost estimates obtained through the procedures described above are shown in Tables V-5 through V-9. Figure V-1 shows the relationship between wastewater flows and effluent control investment costs for the baseline case and for control levels BPT and BAT.

Current Status of Effluent Control in the Industry

Limited information was available concerning the current status of effluent treatment and control in the meat industry.

Discharge Into Municipal or Other Publicly-Owned Wastewater Treatment Systems

There are no recent publications with reliable estimates of the proportion

Table V-5. Baseline effluent control costs - 1972

Cost Item	EPA	DPRA Large	DPRA Medium	DPRA Small
A. Simple slaughterhouse				
Investment	$256,000	$401,000	$289,000	$109,000
Total annual cost	56,400	88,300	63,800	24,000
Capital	25,600	40,100	28,900	10,900
Depreciation	9,500	14,800	10,700	4,000
Operating	21,300	33,400	24,200	9,100
B. Complex slaughterhouse				
Investment	457,000	457,000	341,000	134,000
Total annual cost	90,800	90,800	67,600	26,500
Capital	45,700	45,700	34,100	13,400
Depreciation	16,500	16,500	12,300	4,800
Operating	28,600	28,600	21,200	8,300
C. Low-process packinghouse				
Investment	430,000	466,000	350,000	141,000
Total annual cost	85,600	92,900	69,700	28,200
Capital	43,000	46,600	35,000	14,100
Depreciation	15,600	16,900	12,700	5,100
Operating	27,000	29,400	22,000	9,000
D. High-process packinghouse				
Investment	511,000	550,000	429,000	170,000
Total annual cost	99,300	107,000	83,400	33,000
Capital	51,100	55,000	42,900	17,000
Depreciation	18,200	19,600	15,300	6,000
Operating	30,000	32,400	25,200	10,000

Table V-6. BPT, incremental effluent control costs, above baseline, 1972 costs

Cost Item	EPA	DPRA Large	DPRA Medium	DPRA Small
A. Simple slaughterhouse				
Investment	$ 86,000	$132,000	$ 92,000	$ 37,000
Total annual cost	20,500	31,300	21,800	8,900
Capital	8,600	13,200	9,200	3,700
Depreciation	3,200	5,000	3,400	1,400
Operating	8,700	13,100	9,200	3,800
B. Complex slaughterhouse				
Investment	$150,000	148,000	110,000	44,000
Total annual cost	41,600	41,000	30,500	12,100
Capital	15,000	14,800	11,000	4,400
Depreciation	5,700	5,600	4,200	1,700
Operating	20,900	20,600	15,300	6,000
C. Low-process packinghouse				
Investment	141,000	151,000	117,000	47,000
Total annual cost	35,700	38,100	29,600	11,900
Capital	14,100	15,100	11,700	4,700
Depreciation	5.300	5,600	4,400	1,700
Operating	16,300	17,400	13,500	5,500
D. High-process packinghouse				
Investment	159,000	174,000	140,000	56,000
Total annual cost	44,100	48,400	38,300	15,600
Capital	15,900	17,400	14,000	5,600
Depreciation	6,100	6,700	4,800	2,200
Operating	22,100	24,300	19,500	7,800

Table V-7. BAT, Incremental effluent control costs, above baseline, 1972 costs

Cost Item	EPA	DPRA Large	DPRA Medium	DPRA Small
A. Simple slaughterhouse				
Investment	$457,000	$642,000	$473,000	$192,000
Total annual cost	168,900	237,000	174,600	71,100
Capital	45,700	64,200	47,300	19,200
Depreciation	29,200	41,000	30,200	12,400
Operating	94,000	131,800	97,100	39,500
B. Complex slaughterhouse				
Investment	716,000	709,000	561,000	221,000
Total annual cost	299,100	296,400	234,300	92,300
Capital	71,600	70,900	56,100	22,100
Depreciation	45,800	45,400	35,800	14,100
Operating	181,700	180,100	142,400	56,100
C. Low-process packinghouse				
Investment	677,000	721,000	462,000	233,000
Total annual cost	261,500	279,100	200,600	90,300
Capital	67,700	72,100	46,200	23,300
Depreciation	27,800	46,200	32,800	14,900
Operating	166,000	160,800	121,600	52,100
D. High-process packinghouse				
Investment	792,000	826,000	675,000	267,000
Total annual cost	320,800	334,600	273,300	108,100
Capital	79,200	882,600	67,500	26,700
Depreciation	50,700	52,900	43,100	17,100
Operating	190,900	199,100	162,700	64,300

Table V-8. BPT, total effluent control costs, 1972 basis

Cost Item	EPA	DPRA Large	DPRA Medium	DPRA Small
A. Simple slaughterhouse				
Investment	$342,000	$533,000	$381,000	$146,000
Total annual cost	76,900	119,600	85,600	32,900
Capital	34,200	53,300	38,100	14,600
Depreciation	12,700	19,800	14,100	5,400
Operating	30,000	46,500	33,400	12,900
B. Complex slaughterhouse				
Investment	607,000	605,000	451,000	178,000
Total annual cost	132,400	131,800	98,100	38,600
Capital	60,700	60,500	45,100	17,800
Depreciation	22,200	22,100	16,500	6,500
Operating	49,500	49,200	36,500	14,300
C. Low-process packinghouse				
Investment	571,000	617,000	467,000	188,000
Total annual cost	121,300	131,000	99,300	40,100
Capital	57,100	61,700	46,700	18,800
Depreciation	20,900	22,500	17,100	6,800
Operating	43,300	46,800	35,500	14,500
D. High-process packinghouse				
Investment	670,000	724,000	569,000	226,000
Total annual cost	143,400	155,400	121,700	48,600
Capital	67,000	72,400	56,900	22,600
Depreciation	24,300	26,300	20,100	8,200
Operating	52,100	56,700	44,700	17,800

Table V-9. BAT, total effluent control costs, 1972 basis

Cost Item	EPA	DPRA Large	DPRA Medium	DPRA Small
A. Simple slaughterhouse				
Investment	$ $713,000	$1,043,000	$762,000	$301,000
Total annual cost	225,300	325,300	238,400	95,100
Capital	71,300	104,300	76,200	30,100
Depreciation	38,700	55,800	40,900	16,400
Operating	115,300	165,200	121,300	48,600
B. Complex slaughterhouse				
Investment	1,173,000	1,166,000	902,000	355,000
Total annual cost	389,900	387,200	301,900	118,800
Capital	117,300	116,600	90,200	35,500
Depreciation	62,300	61,900	48,100	18,900
Operating	210,300	208,700	163,600	64,400
C. Low-process packinghouse				
Investment	1,107,000	1,187,000	928,000	374,000
Total annual cost	347,100	372,000	293,500	118,500
Capital	110,700	118,700	92,800	37,400
Depreciation	43,400	63,100	49,700	20,000
Operating	193,000	190,200	151,000	61,100
D. High-process packinghouse				
Investment	1,303,000	1,376,000	1,104,000	437,000
Total annual cost	420,100	441,600	356,700	141,100
Capital	130,300	137,600	110,400	43,700
Depreciation	68,900	72,500	58,400	23,100
Operating	220,900	231,500	187,900	74,300

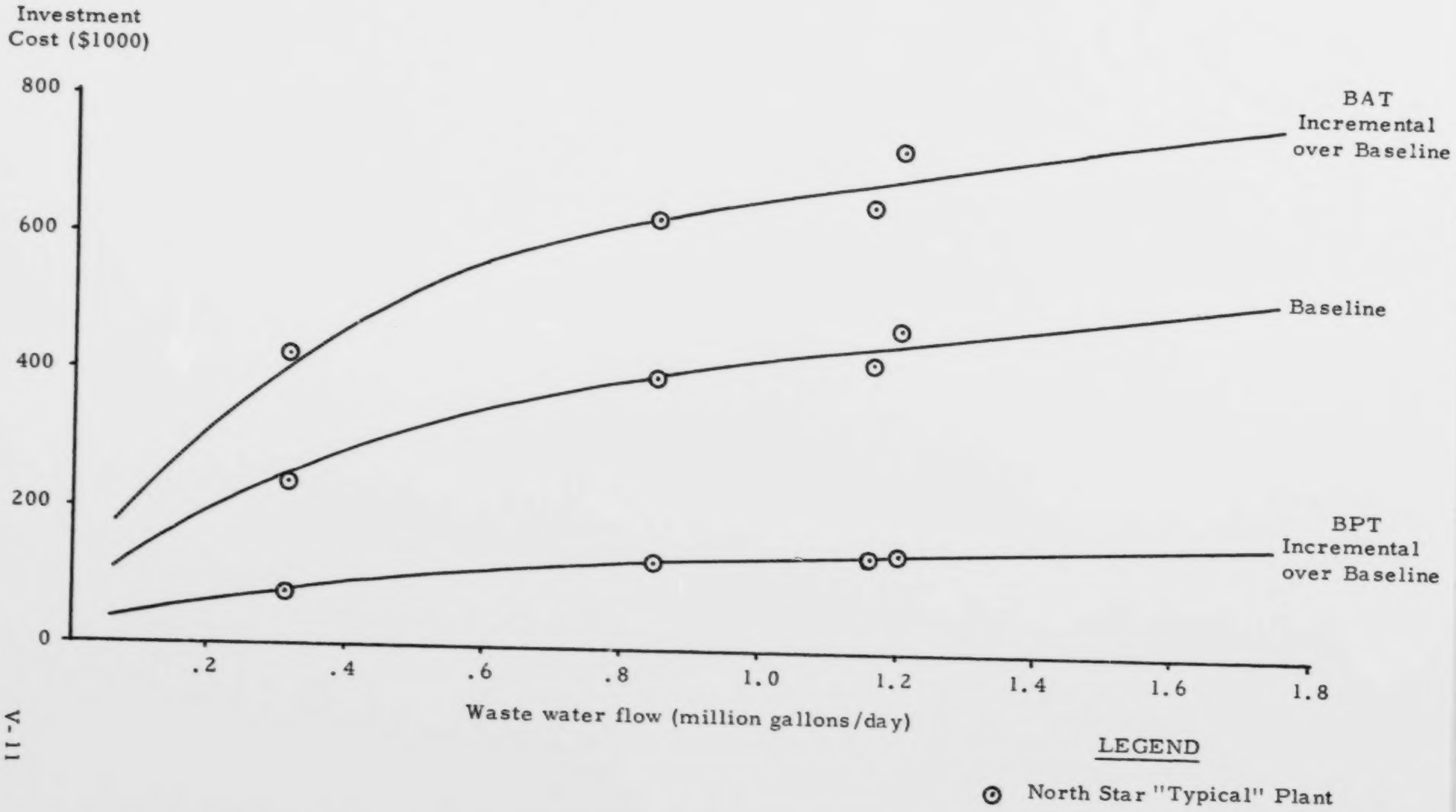

Figure V-1. Baseline, BPT and BAT Effluent Control Investment Costs in 1971 Dollars.

of meat plants which discharge into municipal sewers. Because guidelines analyzed in the present study apply only to direct dischargers, the industry was divided into municipal dischargers and direct dischargers. The best information attainable within the limitations imposed upon this study was based upon surveys conducted by North Star Research Institute for the Environmental Protection Agency. The estimates are as follows:

Plant Type	Municipal Dischargers (%)	Direct Dischargers (%)
Simple Slaughterhouse	56	44
Complex Slaughterhouse	29	71
Low-process Packinghouse	70	30
High-process Packinghouse	59	41

When referring to municipal discharge packinghouses collectively, this analysis uses the average of low-process and high-process percentages--64 percent.

Primary treatment systems

Virtually all plants have primary treatment systems to remove settleable solids and most grease. No effluent discharge matter from meat plants was reported which would interfere, pass through, or otherwise be incompatible with a well-designed and operated, publicly-owned wastewater treatment plant.

Thirty percent of the 85 plants surveyed by North Star Research Institute for EPA, use dissolved air flotation as a primary treatment, either alone or with screens or a catch basin. A higher proportion of slaughterhouses use such a system than do packinghouses.

Secondary treatment systems

The survey of plants showed the following secondary treatment systems used by the plants in the sample.

Type of plant	Type of secondary treatment			
	Municipal (%)	Anaerobic + aerobic lagoons (%)	Other (%)	Total (%)
Simple slaughterhouse	56	33	11	100
Complex slaughterhouse	29	65	6	100
Low-process packing-house	70	11	19	100
High-process packing-house	59	14	27	100
All plants	55	28	17	100

This sample distribution shows that the major type of treatment is the municipal system for all plant types except the complex slaughterhouse. The latter significantly utilizes lagoon systems to a much greater degree (more than double) than do other types of plants. Many of the complex slaughterhouse plants are large scale, "kill and chill" operations which tend to locate in the country adjacent to major feeding areas.

A further estimate, based on the plant survey, indicates that the relative importance of lagoons in relation to the estimated percent of industry flow treated in 1971 is as follows:

Type of plant	Percent of industry flow treated by anaerobic and aerobic lagoons (%)
Simple slaughterhouse	75
Complex slaughterhouse	90
Low-process packinghouse	40
High-process packinghouse	35

Again the greater relative importance of lagoon systems for treatment of slaughterhouse effluents is apparent.

This impact analysis assumed that all direct discharges have baseline treatment systems in place. Results of the plant survey and discussions with industry specialists indicate this is a reasonable assumption. A few plants still have only primary treatment systems (probably less than 5 percent of the direct dischargers), but it is believed those plants are older and less efficient and will be forced to cease operations in the next few years because of competitive market forces not related to effluent treatment guidelines.

VI. IMPACT ANALYSIS

The imposition of effluent controls on the livestock slaughtering and meat packing industry will have both direct and indirect impacts on the industry and its suppliers, on consumers, and on communities in which meat plants are located. An analysis was made, for specified effluent control levels, in both quantitative and qualitative terms, of the impact which are expected.

The following types of impacts have been analyzed:

A. Price Effects
B. Financial Effects
C. Production Effects
D. Employment Effects
F. Community Effects
G. Balance-of-Payment Effects

A. Price Effects

The role of price effects in this analysis is critical. The meat packing industry is one with a low value added and a very low profit margin in relation to sales. A minor change in wholesale meat prices while live animal prices are constant results in substantical changes in industry profits. The converse of this argument is also true. Hence, if even a minor increase in packer margins results from mandatory effluent treatment practices, the adverse economic impacts of those controls on the industry will be ameliorated or, possibly, eliminated. We expect this to be the case in the long run under BPT guidelines; however, the situation under BAT guidelines is less encouraging.

Long Run Effects

The theoretical considerations involved in analyzing price effects were presented earlier and need not be repeated. However, three critical points should be recalled. First, historical price movements at the farm and retail level have been highly correlated indicating that packers have little control over price at either level. Second, the farm level demand for beef is derived from the consumer demand at retail. If packers could act in unison, they could effectively shift the derived farm demand curve to the left while the consumer demand curve remained constant. These two seemingly inconsistent points are partially explained by the third. If consumer demand is shifting to the right (e.g., due to population increases or income elasticity effects) and the long run supply curve is also shifting to the right (e.g. due to technological advances), increases in packer margins may be partially masked with both consumer and farm prices increasing. However, the primary reason packers cannot control price margins is that the industry is intensely competitive. As noted earlier, the market power of the old giant packers has been eroding. Given the current and anticipated number and diversity of firms in the industry, collective actions to control long run margins would surely be futile. Ironically, this very characteristic makes margin increases likely in the long run under BPT controls.

The incremental costs of the BPT treatment described above are very small when compared to sales volume -- less than 0.2 percent for each of the model plants (Table VI-1). [1/] As a result, the expected number of plant closures attributable to BPT guidelines are insignificant. The capacity lost due to such closures could easily be absorbed by the remaining plants.

Even though closures would not reduce capacity sufficiently to induce price changes, the market system would eventually allow margins to widen enough to cover BPT effluent treatment costs for large plants in the long run (assuming production technology remains constant). The average wholesale price increase required to cover BPT treatment in the large plants would run about 0.05 percent and such a small price change would be most difficult to trace through the market system. However, we do feel an initial price response would develop as a result of decreased competition for live animals, for packers will try to maintain current profits by paying less for live animals. The ability of packers to lower live prices will depend partially upon the hog and cattle cycles. We feel, a price change at the farm level would be more likely when livestock available for slaughter are increasing. A price reduction at the farm level would encourage farmers to reduce livestock production which, eventually, will mean consumers would find meat a little less plentiful and a little more expensive.

[1/] Treatment costs as percent of sales are calculated on the basis of a 32 year cash flow (30 years of operation) with both treatment costs and revenues discounted back to year zero prior to calculating the percentage.

Table VI-1. Price change required to pay for incremental pollution control*

	Level I above Baseline	Level II above Baseline	Level II above Level I
Simple beef slaughter			
Small	0.13	1.07	0.94
Medium	0.06	0.43	0.37
Complex beef slaughter			
Medium	0.07	0.59	0.52
Large	0.05	0.37	0.32
Simple beef-hog slaughter			
Small	0.15	1.24	1.09
Medium	0.07	0.50	0.43
Complex beef-hog slaughter			
Medium	0.09	0.68	0.59
Large	0.06	0.43	0.37
Low-process packinghouse			
Small	0.14	1.07	0.93
Medium	0.06	0.38	0.32
Large	0.04	0.28	0.24

* Price change is calculated as treatment costs as a percent of sales where a 32 year cash flow (30 years of operation plus 1 year for start-up and 1 year for shut-down) is used and both treatment costs and revenues are discounted back to year zero prior to calculating the percentage.

Up to this point, the implication has been that all firms in the industry will face identical discharge standards, but that will not be the case. Though plants connected to municipal sewers are not included in the standards to which this report is addressed, we do know of several plants where substantial pre-treatment facilities are in place or being planned. In addition, those same firms are sharing the cost burden of the municipal treatment system. In addition, we anticipate municipal effluent treatment systems to be upgraded and, hence, more costly to the user. We expect, also, that pre-treatment requirements will be applied in more cases. In that regard, it is useful to note that the slaughter of a 1,000 pound steer in a simple slaughter plant generates a wasteflow of 639 gallons compared to per capita household wasteflow of about 75-100 gallons. The wasteflow of a large simple slaughter plant, thus approaches that of a residential community of 7,000 people (assuming no business establishments were included in the community). Alternatively, the same plant's wasteflow would probably equal the total flow of a typical town of about 3,500 population. For a high-process packinghouse, the population equivalents would be over twice as great as those for a simple slaughterhouse.

Realizing that meat packing plants discharging into sewers incur a treatment cost and that those plants are reported by North Star to represent more than 50 percent of the industry, their influence on price determination cannot be ignored. If their treatment costs are lower, new plants would, in most cases, locate where sewers are available, price increases would be smaller and a disproportional number of non-sewered plants would close. If, on the other hand, such plants costs were higher, the reverse effect would be expected. Hence, to complete the price analysis, an assumption about treatment costs for sewered plants had to be made. Economies of scale suggest that municipal treatment costs should be lower than private treatment costs.

Federal subsidies of municipal treatment plants would also tend to favor the growth of meat plants using such treatment centers. However, municipal plants in small towns and cities often aren't designed solely from an economic point of view. Municipal treatment capacity in such communities often exceeds wasteflow by a factor of 2 or more -- sometimes as high as 4. Hopes for growth, politics, and a host of other factors frequently affect the design and operation of municipal plants. Conceivably, then, municipal costs may be higher than private treatment costs; indeed, North Star indicates that in its draft report. In view of the absence of adequate contrary data, we have assumed that municipal treatment (plus any required pretreatment) will equal private industrial treatment costs in 1977. It is further assumed that the current market price reflects the baseline condition (i.e., anaerobic +

aerobic lagoons) and that the baseline cost equals currently prevailing treatment costs for sewer connected plants. Finally, it is assumed that municipal treatment costs in 1983 will equal 1977 costs and, hence, will be less expensive than BAT treatment costs.

For those plants not discharging into municipal sewers, we feel a weighted average red meat wholesale price increase of 0.3 percent should cover the incremental cost of BAT treatment. However, it is unlikely that such a price change would prevail in the long run. About 55 percent of the plants are connected to municipal sewers. Except for possibly a few in isolated areas, the competitive power of those plants should be sufficient to hold margins down to the levels expected with BPT treatment. Those firms requiring private treatment systems will be forced to close or absorb the added cost of BAT treatment. New firms faced with NSPS guidelines in 1983 would find an added inducement to locate in areas where they could connect to municipal treatment systems.

Short Run Effects

The short run impact of pollution controls may differ substantially from the long run impacts. NSPS guidelines require that new plants meet the BPT guideline for existing plants and that guideline implicitly requires the baseline installation. Most firms currently at baseline treatment, thus, should not be seriously affected by the BPT guidelines. The installation costs to attain BPT treatment standards may be excessive, however, for plants that must undergo substantial capital improvements prior to 1983. If such costs added to those for capital improvements prove too high in view of expected returns, such plants may have to close.

With BPT controls in place, new small plants may be justifiable only in those unusual circumstances in which the possibility of exercising market power is greater than what is typical in the industry. Most new plants will be medium and large sized and most will engage in processing. Plants dropping out would most likely be small -- especially small slaughter plants. Under such conditions, economies of scale experienced in waste treatment would tend to dampen price effects once the new plants were operational.

The short run effects starting in 1982 or 1983 as a result of BAT guidelines should be greater than the long run effects, but the degree depends upon the psychological reaction of the industry to the standards and technology proposed. If the standards are viewed as totally unrealistic and the technology as unproven and impractical, the relative short run closures and price effects could be very great in relation to long run impacts. The extent of such a reaction cannot be presently determined.

Given the industry's existing economies of scale plus the substantial waste treatment economies of scale reported above, significantly major short run effects could vastly alter the structure of the industry. Slaughter-only plants and small packing plants would be placed at a disadvantage. Unless these projected cost advantages are offset by increased transportation costs or differential wage rates or other costs, an excessive short run disequilibrium could result in plants two to three times larger than those reported in 1973 and a consequent reduction of industry competition.

Our long run analysis has been based upon the assumption that a disruptive short run adjustment will not occur. If such did materialize as a result of BAT requirements, our long run analysis could be in error. Closures of small and medium plants would be greater than predicted. Too, if a few large firms gained substantial market power, the decreased competition might also result in an increase in the long run price level.

B. Financial Effects

In order to measure the financial impacts of proposed effluent controls on the livestock slaughter and meat packing industry, income rates of return and cash flows were calculated for the various sizes and types of model plants with and without effluent control costs. Rates of return were calculated on average fixed investment and on sales. Analyses made include the following:

1. Pre-tax net income
2. Pre-tax rate of return on average invested capital
3. After-tax rate of return on average invested capital
4. After-tax rate of return on sales
5. Estimated cash flow as a percent of average invested capital
6. Estimated annual cash flows.

Pre-Tax Net Income

The impact of alternative effluent treatment levels on specified types and sizes of model livestock slaughter plants and meat packinghouses is shown in Table VI-2. In general, the imposition of BPT controls result in a moderate income reduction, and BAT controls impact severely on incomes.

Slaughter plant income is more reduced than is that of packinghouses, and small plants show greater relative reductions in income than do larger plants. The relative income impacts are as follows:

Type and size of plant	Percent reduction from "baseline" income	
	BPT (%)	BAT (%)
Simple beef slaughter		
Small	26	183
Medium	5	46
Complex beef slaughter		
Medium	9	73
Large	6	45
Simple beef-hog slaughter		
Small	15	120
Medium	7	54
Complex beef-hog slaughter		
Medium	9	71
Large	6	41
Low-process packinghouse		
Small	10	72
Medium	4	24
Large	2	15

Pre-Tax Rate of Return on Average Invested Capital

The pre-tax rate of return on average invested capital for specified types and sizes of plants as affected by alternative effluent control levels is shown in Table VI-3. The impact pattern is similar to that describing pre-tax income effects.

Table VI-2. Pre-tax net income for model meat plants, alternative effluent treatment levels, assuming no price change

	Baseline	BPT	BAT
	($000)	($000)	($000)
Simple beef slaughter			
Small	35	26	-29
Medium	315	299	170
Complex beef slaughter			
Medium	322	292	88
Large	651	609	355
Simple beef-hog slaughter			
Small	59	50	-12
Medium	322	301	148
Complex beef-hog slaughter			
Medium	330	300	96
Large	720	678	424
Low-process packinghouse			
Small	125	113	35
Medium	846	816	645
Large	1,998	1,960	1,704

Table VI-3. Pre-tax rate of return on average invested capital for model meat plants, alternative effluent treatment levels, assuming no price change

	Baseline	BPT	BAT
	(%)	(%)	(%)
Simple beef slaughter			
Small	8.0	6.2	0
Medium	14.0	12.9	7.3
Complex beef slaughter			
Medium	14.1	12.7	4.5
Large	15.9	14.7	8.6
Simple beef-hog slaughter			
Small	12.0	10.2	0
Medium	14.4	13.3	6.7
Complex beef-hog slaughter			
Medium	14.5	13.1	4.9
Large	18.2	16.9	10.4
Low-process packinghouse			
Small	10.9	9.7	3.1
Medium	16.5	15.8	12.3
Large	21.7	21.1	18.0

The imposition of BPT controls reduces the rate of return slightly. BAT controls reduce rates of return to near or below zero for small model plants.

BPT controls reduce returns, over the baseline case, by nearly 2 percent for small plants, 1 - 1.5 percent for medium sized plants and 0.5 to 1.0 percent for large plants.

BAT controls have substantial impacts on the returns of small plants, dropping them by 5 percent or more. Medium and large model slaughter plant returns are reduced by about 6 percent, and medium and large packinghouse returns drop by about 3 percent.

After-Tax Return on Average Invested Capital

After-tax returns on average invested capital are shown in Table VI-4. Returns are relatively low even in the baseline situation. BPT controls reduce returns slightly and BAT controls reduce after-tax returns to less than 6 percent for all slaughter plants and for small packinghouses. Only medium and large packinghouses have after-tax returns exceeding 6 percent under BAT controls.

After-Tax Return on Sales

The meat packing and livestock slaughter industry generally operates on after-tax returns on sales of one-half to one and one-half percent. Table VI-5 presents the model plant after-tax returns on sales for alternative effluent control levels. With baseline controls in place, returns for slaughter-only plants average near 0.5 percent, and packinghouses average near 1.0 percent. The imposition of BPT controls reduces returns on sales slightly. BAT controls reduce returns on sales for all slaughter plants to extremely low (0.33 or lower) levels. Packinghouses survive fairly well with BPT controls in place, but BAT controls have a substantial impact on the small plants.

Estimated Cash Flow as a Percent of Average Invested Capital

Estimated cash flows on average invested capital for the model meat packing plants are shown in Table VI-6. In the baseline case, simple slaughter plants have cash flow percentages nearly equal to those of complex plants of the same size and species. The ratios are slightly more favorable for the combined beef-hog plants than for beef only plants. However, in actual practice, most hogs are cut and processed by the same firm that does the slaughtering. Too, because most hog

Table VI-4. After-tax return on average invested capital for model meat plants, alternative effluent treatment levels, assuming no price change

	Baseline	BPT	BAT
	(%)	(%)	(%)
Simple beef slaughter			
Small	4.1	3.3	< 0
Medium	7.3	6.7	3.8
Complex beef slaughter			
Medium	7.3	6.6	2.3
Large	8.3	7.7	4.5
Simple beef-hog slaughter			
Small	6.3	5.5	< 0
Medium	7.5	7.0	3.5
Complex beef-hog slaughter			
Medium	7.5	6.7	2.4
Large	9.5	8.9	5.5
Low-process packinghouse			
Small	5.7	5.1	1.7
Medium	8.6	8.2	6.4
Large	11.3	11.0	9.4

Table VI-5. After-tax return on sales for model meat plants, alternative treatment levels, assuming no price change

	Baseline	BPT	BAT
	(%)	(%)	(%)
Simple beef slaughter			
Small	0.28	0.21	<0
Medium	0.43	0.40	0.23
Complex beef slaughter			
Medium	0.44	0.40	0.12
Large	0.45	0.42	0.24
Simple beef-hog slaughter			
Small	0.56	0.48	<0
Medium	0.52	0.48	0.25
Complex beef-hog slaughter			
Medium	0.52	0.47	0.15
Large	0.57	0.53	0.33
Low-process packinghouse			
Small	0.80	0.73	0.24
Medium	0.94	0.91	0.72
Large	1.11	1.08	0.94

carcasses are sold by formula pricing, we may have reflected a small portion of the processing margin in the carcass price when estimating the typical formula price (wholesale prices of whole hog carcasses are not published). The cash flows are higher for processing than for slaughter as is generally acknowledged in the industry. Cash flow percentages vary moderately by size within a segment.

BPT and BAT controls reduce the cash flows. Although the BPT cash flows are only slightly less than baseline, the BAT impact is substantial if no price increases are assumed.

Estimated Annual Cash Flows

Estimated cash flows in dollars appear in Table VI-7. These data verify the conclusions extrapolated from Table VI-6. The grossly differential impacts of BAT treatment requirements can be readily seen when dollar cash flows are examined. The percentage reduction from baseline to BAT ranges from 6 percent for the large packinghouse to 98 percent for the small, simple beef slaughter plant.

C. Production Effects

BPT guideline requirements are not expected to significantly affect red meat production volume. The impact of BAT water pollution control requirements on the production of meat and processed meat products will be felt principally in the closing of small plants whose volume of production is such that the incremental costs required to install additional water pollution control systems make the continued operation of these plants uneconomic. However, such plants account for a small part of total industry production.

Production Curtailment

No significant long run curtailment of total production resulting from the imposition of increased water pollution control requirements is expected. Although aggregate volume data by plant size are not available, the value of shipments in relation to employment in 1967 data are available and indicate the relative volumes of different sizes of plants.

Table VI-6. Estimated cash flow on average invested capital for model meat plants, alternative effluent treatment levels, assuming no price change

	Primary	BPT	BAT
	(%)	(%)	(%)
Simple beef slaughter			
Small	11.0	9.9	0.2
Medium	14.4	13.8	11.4
Complex beef slaughter			
Medium	14.5	13.7	10.0
Large	15.1	14.5	11.7
Simple beef-hog slaughter			
Small	13.6	12.7	5.5
Medium	14.8	14.2	11.2
Complex beef-hog slaughter			
Medium	15.0	14.2	10.5
Large	16.7	16.1	13.1
Low-process packinghouse			
Small	14.2	13.6	10.7
Medium	17.2	16.8	15.3
Large	19.9	19.6	18.1

Table VI-7. Estimated cash flow for model meat plants, alternative effluent treatment levels, assuming no price change

	Primary	BPT	BAT
	($000)	($000)	($000)
Simple beef slaughter			
Small	48	44	1
Medium	323	315	275
Complex beef slaughter			
Medium	331	319	245
Large	617	601	508
Simple beef-hog slaughter			
Small	67	64	25
Medium	332	324	272
Complex beef-hog slaughter			
Medium	342	330	256
Large	658	642	549
Low-process packinghouse			
Small	163	159	132
Medium	886	874	814
Large	1,826	1,812	1,719

Meat Packing - 1967

Number of employees	Plant size	Number of plants	Value of shipments	
			Millions of $	% of total
Less than 20	Small	1,742	517.4	3.3
20 - 49	Small	420	1,235.8	7.9
50 - 99	Medium	221	1,726.4	11.1
100 - 249	Medium	169	2,827.9	18.2
250 - 499	Large	84	3,388.9	21.7
500 - 999	Large	30	1,835.8	11.8
1,000 - 2,499	Large	23	2,246.5	14.4
2,500 - and over	Large	8	1,797.4	11.6
Total		2,697	15,576.1	100.0

In terms of the large, medium and small classifications used in this study, large plants would employ 250 or more employees, medium plants 50 to 249 and small plants 49 or fewer. Based on these employment levels, the volume relationships in 1967 were:

Small plants	11.2 percent of total shipments
Medium plants	29.3 percent of total shipments
Large plants	59.5 percent of total shipments

Since the livestock slaughter and meat packing industry generally operates at less than 100 percent of capacity (85 percent utilization was assumed in this report), and since plant closures would occur mainly among small plants which account for slightly over 10 percent of total production, the remaining plants could absorb the volume lost through plant closures. In reality, the principal determinant of livestock slaughter volume is the number of slaughter livestock produced and marketed off farms. If necessary, the remaining plants could extend their work week and start double-shift operations to pick up the volume from plants which close. [1]

Plant Closures

Plant closures in the meat packing and slaughter industry would be greatest among small plants and would affect slaughter-only plants more than meat packinghouses.

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[1] In some plants cooler space is not adequate to allow double shifts for prolonged periods; however, many plants have enough cooler space for double shifts and most have enough for at least one and one-half shifts.

It is difficult to distinguish those closures resulting from the imposition of effluent controls from those resulting from other reasons (i.e., obsolescence, poor management); in the analysis of projected plant closures, however, historical trends in plant numbers in this industry were considered. A further complicating factor is that, in spite of declining plant numbers, total industry slaughter volume has risen rapidly, especially in recent years. This increasing total demand for meat and meat products has been the result of two principal factors: (1) increasing population and (2) increasing per capita consumption. The latter has been largely influenced by gains in disposable personal incomes since the demand for beef is income-elastic.

DPRA estimated the base numbers of plants in 1977 and 1983 on the assumption that all existing (1973) plants have controls in place equivalent to baseline conditions. The DPRA base number of plants, shown for 1977 and 1983 in Tables VI-10, VI-12, and VI-14 reflect changes in plant numbers related to non-effluent control factors. For example, as many small plants close and the total demand for red meats increases, new construction in the industry will be primarily directed toward large plants. Some medium-sized plants will continue to be built.

a. NSPS guidelines

Table VI-9 shows the estimated percentage of plants operating in 1973 with profits sufficient to warrant replacement investment under NSPS treatment levels, assuming no compensating price increase to offset effluent control costs. Three effluent control conditions are specified: Baseline, Pre-1983 and Post-1983.

Baseline impact - If only baseline effluent controls are specified, and if all plants are valued at replacement cost, the imposition of these controls would make unprofitable nearly all small slaughter plants and meat packinghouses, approximately 75-80 percent of the medium-sized plants, 75 percent of the large beef slaughter plants, over half of the large combined slaughter plants and over 25 percent of the large packinghouses.

Table VI-9. Percentage of plants operating in 1973 with profits sufficient to warrant replacement investment under NSPS treatment levels, assuming no price change

Type and size of plant	Baseline	Pre-1983*	Post-1983*
	%	%	%
Simple beef slaughter			
Small	< 1	0	0
Medium	10	6	0
Complex beef slaughter			
Medium	18	4	0
Large	26	19	1
Simple beef-hog slaughter			
Small	3	1	0
Medium	13	9	0
Complex beef-hog slaughter			
Medium	12	7	0
Large	46	38	7
Low-process packinghouse			
Small	2	1	0
Medium	31	28	12
Large	72	71	57

* NSPS guideline costs are assumed equal to BPT until 1983 at which time they will equal BAT costs.

Pre-1983 impact - With all values at replacement cost, pre-1983 guidelines would result in additional plants becoming unprofitable, particularly in the medium sized plants where an additional 4 percent (about 12 plants) would become unprofitable. The impact would be less severe on the large plant category.

Post-1983 impact - The imposition of BAT equivalent controls, which add substantial investment and operating costs, would have a severe impact on profits if all plants were valued at replacement cost. All small plants (both slaughterhouses and meat packinghouses) would become unprofitable, as would all medium sized slaughter plants and 88 percent of all medium packinghouses. Less than 10 percent of the large slaughter plants would remain profitable, but 57 percent of the large packinghouses would continue profitable.

In conclusion, the NSPS guidelines are expected to have very little, if any, impact on new packinghouse construction rates. Pre-1983 impacts on slaughter plants would be a larger relative advantage for large plants. Post-1983 impacts would retard plant construction in non-sewer discharge areas, but not drastically. However, unless profit margins widen, the construction of new slaughterhouses in non-sewer discharge areas after 1983 would be difficult.

b. Plant closures, BPT (1977)

Table VI-10 shows projected BPT plant closures. Closures shown are only those which would result from the imposition of BPT requirements and, thus, are in effect incremental above Baseline control levels. The 1977 base numbers indicate the number of plants projected for 1977 without the imposition of BPT controls. As seen from Table VI-10, the imposition of BPT controls is expected to result in one small slaughter plant closure. Although BPT control costs are appreciable and would reduce profits, they are not generally great enough to result in plant shutdowns.

Table VI-10. Projected BPT (1977) effluent control-associated plant closures, meat packing and slaughter plants

Type and size of plant	1977 Base numbers[2]	Projected 1977 closures[2] % of total	Projected 1977 closures[2] Number
Slaughter only plants[1]			
Small	83	< 1	1
Medium	39	-	0
Large	17	-	0
Packinghouses[1]			
Small	247	0	0
Medium	109	0	0
Large	48	0	0
Total	543	-	1

[1] 1973 - 80% of total number of plants are packinghouses. 1977 estimate is that 82.5% of total number of plants would be packinghouses.

[2] Base numbers include only those plants classified as direct dischargers and, hence, exclude those served by municipal sewers.

Table VI-11 shows the combined impact of BPT treatment costs and other factors in terms of expected changes in plant numbers, 1973-1977. A pronounced shift from small to larger plant sizes results. For slaughter plants, small operations are reduced in number by 36 plants or 20 percent by 1977. A loss of 12 medium-size plants (15 percent) and a gain of 8 large plants (36 percent)are projected changes which result both from the construction of new plants and from the expansion of 1973 medium sized plants.

c. Plant closures, BAT

Table VI-12 shows projected BAT plant closures. Those shown are in addition to those resulting from the imposition of BPT controls and are thus incremental in nature. The 1983 base numbers shown in Table VI-12 reflect closures (since 1973) due to the imposition of BPT controls as well as closures due to factors not associated with effluent controls.

The increase in the number of large plants reflects both new plants and the expansion of previous "medium" plants. As seen from Table VI-12, the imposition of BAT controls, without compensating price increases, results in the closure of 71 percent of the small slaughter plants, 12 percent of the medium slaughter plants and 7 percent of the small packing plants. Large plants are not severely impacted. Overall, BAT controls would result in the expected closure of 67 plants.

BAT control systems involve more complex and technically sophisticated waste treatment equipment with the results that both investments and annual costs are substantial. For small plants, investment per plant would be near $250,000 (Table V-7, above) with annual costs of nearly $100,000. Medium plants would require BAT investments of over $500,000 with annual costs of over $250,000. Large plant investments would be near $750,000 and annual costs over $300,000.

Table VI-13 shows the combined impact of BAT control costs, BPT control costs, and other factors on changes in plant numbers between 1973 and 1983. BAT controls, with no compensating price increases would close 45 small slaughter plants, 4 medium slaughter plants and 1 large slaughter plant, 16 small packinghouses and 1 medium packinghouse. The cumulative effect of effluent controls plus the influence of other factors would result in the closure of 65 percent (115 plants) of the small slaughter plants which existed in 1973 and 36 percent (29 plants) of the medium slaughter plants. However, a 55 percent increase (12 plants) is projected

Table VI-11. Projected changes in slaughterhouse and meat packing plant numbers, 1973-1977 due to both effluent controls and other factors[1]

Type and size of plant	Estimated plant nos. 1973	Change in plant nos. due to non-effluent factors[2]		Change in plant nos. due to effluent controls		Total change	Plants remaining, 1977	
		Number	% of 1973	Number	% of 1973	no. plants	Number	of 1973
Slaughter only								
Small	178	-34	-19	- 2[3]	-1	-36	142	80
Medium	80	-12	-15	0	0	-12	68	85
Large	22	+ 8	+36	0	0	+ 8	30	136
Meat packing								
Small	750	-55	- 7	0	0	-55	695	93
Medium	305	+ 2	+ 1	0	0	+ 2	307	101
Large	85	+50	+59	0	0	+50	135	159
Total	1,420	-41	-	-	-	-43	1,377	-

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[1] Includes both sewered plants and direct dischargers.

[2] Anticipated change in plant numbers due to factors not related to effluent control such as obsolescence, poor management, new plant construction, etc.

[3] Assumes 1 sewered plant and 1 direct discharger will be closed due to incremental treatment costs.

Table VI-12. Projected BAT (1983) effluent control-associated plant closures, meat packing and slaughter plants

Type and size of plant	1983 Base numbers [2]	Projected closures by 1983 [3] % of total	Number
Slaughter only plants [1]			
Small	63	71	45
Medium	32	12	4
Large and extra large	20	4	1
Packinghouses [1]			
Small	227	7	16
Medium	110	1	1
Large and extra large	69	0	0
Total	521		67

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[1] 1973 - 80% of total number of plants are packinghouses.
1983 estimate is 85% of total number of plants would be packinghouses.

[2] Includes only those plants classified as direct dischargers.

[3] Assumes plants have met BPT controls in 1977.

Table VI-13. Projected changes in slaughterhouse and meat packing plant numbers, 1973-1983 due to both effluent controls and other factors 1/

Type and size of plant	Estimated plant nos. 1973	Change in plant nos. due to non-effluent factors 2/		Change in plant nos. due to effluent controls		Total change nos. plants	Plants remaining, 1983	
		Number	% of 1973	Number	% of 1973		Number	% of 1973
Slaughter only								
Small	178	- 68	- 38	-47 3/	-26	-115	63	35
Medium	80	- 25	- 31	- 4	- 5	- 29	51	64
Large	22	+ 13	+ 59	- 1	- 5	+ 12	34	155
Meat packing								
Small	750	-110	- 15	-16	- 2	-126	624	83
Medium	305	+ 5	+ 2	- 1	0	+ 4	309	101
Large	85	+110	+129	0	0	-110	195	229
Total	1,420	- 75	-	-69	-	-144	1,276	-

1/ Includes both sewer and direct dischargers

2/ Anticipated change in plant numbers due to the imposition of factors not related to effluent control such as obsolescence, poor management, new plant construction.

3/ Includes 1 sewer and 1 direct discharger closed due to incremental treatment costs during the period, 1973-1977.

for large slaughter plants. Primarily small packinghouses would be shutdown by 1983, but the number (126 plants) represents 17 percent of this industry category. Though little change is projected for medium-sized packinghouses, large packinghouses are expected to more than double in number by 1983.

d. Very small plant closures

There are approximately 4,600 very small slaughterhouses, meat packinghouses, custom butchers and locker plants which slaughter. These plants average less than a 2 million pounds annual kill, (a kill rate of 7-8, 1,040-pound steers per day for 250 days per year). Many plants kill even less. For example, there are 2,600 frozen food locker plants which slaughter approximately only 500,000 pounds annually, less than 2 steer-equivalents per day. Many other small custom butchers are in this category.

EPA estimated that 50 percent of these very small plants may be discharging into municipal sewers and the balance use either lagoon systems and septic tanks or discharge raw effluent.

There are no reliable effluent cost data for these plants. EPA estimates an average investment cost of $10,000 for locker plants with estimated annual costs totaling $2,000: capital cost $1,000, depreciation $400, and other direct operating costs $600.

A large proportion of these very small slaughterers kill livestock as a service or as an adjunct to another business. Locker plants, retail butchers, small sausage processors, custom slaughterers, institutions (educational and others), specialized food processors and other similar firms are included in this group together with very small slaughterhouses. Except for locker plant data, no information exists regarding the relative numbers of such firms.

In most instances, those firms would survive for which slaughtering is a service (e.g. locker plants) or a necessary, but minor part, of overall operations. This could account for as many as 3,600 units. Approximately 200 educational and other institutions (prisons, etc.) would survive for their costs are supported by public funding. Of the remaining 800 plants, 400 are estimated to be discharging into municipal sewers. Their low effluent discharge volume and the possibility of its further reduction by improved in-plant operating procedures make it likely that they will also survive.

The remaining 400 very small slaughterers have low kill volumes (2 to 3 head per day as an average) and killing and cutting practices which result in low effluent volumes. Most of these small killers have established sources of disposal for offal and blood (often sold to renderers) and their liquid wastes could, in most cases, be handled by the apparently widespread use of ordinary septic tank systems. Doubtless some closures would result among plants which discharge raw sewage into streams, but only a small number of plants would be affected and the impact on production and employment would be insignificant.

D. Employment Effects

Employment Trends

Employment in the meat packing industry has declined steadily during the past 20 years in spite of a steady uptrend in production volume.

Year	Employment in meat packing[1/]	
	Total employees (000)	Production workers (000)
1954	220.2	167.8
1958	201.0	150.9
1963	181.0	138.8
1967	170.5	130.8

[1/] Source: U.S. Department of Commerce, Census of Manufactures.

Although declining employment and increasing output would mean that production per man-hour has increased, part of this increase in labor productivity is the result of automation and other technological improvements in plant and equipment.

A relatively large proportion (75 percent) of the total employees of meat packing and meat processing industries are production workers.

Table VI-14 shows employment by firm size. Although in the meat packing industry a high proportion of the firms (65 percent in 1967) employ fewer than 20 employees, they account for only a small percent (4.5 percent in 1967) of the total industry employment. At the other end of the scale, 8 large firms (0.3 percent) employed 15.3 percent of the industry total in 1967.

Wages

Wages in the meat packing industry are relatively high. In terms of total payrolls, average annual wages in 1972 ranged from $6,700 in small plants to over $10,000 in large plants. Wage distribution in 1967 was as follows:

No. employees per plant	Average annual wage	
	1967[1]	Estimated 1972
1-4	$5,353	$6,700
5-9	5,500	6,900
10-19	5,366	6,700
20-49	6,060	7,600
50-99	6,450	8,100
100-249	6,971	8,700
250-499	7,537	9,400
500-999	7,701	9,600
1,000-2,499	8,044	10,100
2,500+	8,321	10,400

[1] 1967 wages inflated by 1972 CPI.

[2] Source: U.S. Department of Commerce, Census of Manufacturers.

Unemployment Associated with Plant Closures

As indicated in section C, the following plant closures might be anticipated as a result of the imposition of water pollution controls on the meat industry.

Table VI-14. Employment in the meat industry, employees per firm, by size group, 1958, 1963, 1967[1]

Number of employees	Meat Packing					
	1967		1963		1958	
	No. plants	Employees (000)	No. plants	Employees (000)	No. plants	Employees (000)
Less than 20	1,742	7.6	2,016	9.9	1,824	10.0
20-99	641	28.6	677	29.2	668	29.0
100-499	253	54.3	232	49.8	231	51.5
500-999	30	22.1	34	24.7	38	26.1
1,000-2,499	23	31.7	24	36.5	30	46.5
2,500 or more	8	26.1	9	31.1	10	37.7
Total	2,697	170.5	2,992	180.9	2,801	200.8

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[1] Source: U.S. Department of Commerce, Census of Manufacturers.

	Number Closed	
Type & size of plant	BPT No price increase	BAT No price increase
Meat packinghouses		
Small	0	16
Medium	0	1
Slaughter plants		
Small	1	45
Medium	0	4
Large	0	1

The employment and payroll loss as a result of these plant closures were estimated to be as shown in Tables VI-15 and VI-16. In summary, these losses were as follows:

Level of Control	Jobs Lost	Payroll Lost ($000)
BPT, no price increase	25	$ 130
BAT, no price increase	2,765	21,890

Possibility of Reemployment in New Plants

There would be little likelihood that new plants would be built in the same area to replace small or obsolete plants which were forced to close because of their inability to add necessary equipment to comply with water pollution control requirements. Small meat packing, slaughter or processing plants face substantial disadvantages due to economies of scale in slaughtering, processing and water pollution control operations. As a result, it is doubtful that these small plants would be replaced since medium or large plants are widely distributed geographically and could absorb the added volume represented by the loss of these small plants. Obsolete plants are most likely to persist in areas where the meat packing and processing industries are declining and, as a result, there would be little inducement to replace plants in these areas.

Table VI-15. Estimated unemployment and wage losses resulting from imposition of BPT effluent controls on the meat industry, no compensating price increases

Type and size of plant	Est. No. closures 1/	Est. employees per plant		Estimated unemployment			Est. annual salary or wage		Estimated wage loss		
		Sup. & sales	Prod'n.	Sup. & sales	Prod'n.	Total	Sup. & sales	Prod'n.	Sup. & sales	Prod'n.	Tota
									(000)	(000)	(000
Slaughter plant, small medium	1	5	20	5	20	25	10,000	6,000	$10	$120	$130
Total	1	-	-	5	20	25	-	-	$10	$120	$130

1/ Assumes plants have already met Baseline effluent control requirements.

Table VI-16. Estimated unemployment and wage losses resulting from imposition of BAT effluent controls on the meat industry, no compensating price increases

Type and size of plant	Est. No. closures 1/	Est. employees per plant		Estimated unemployment			Est. annual salary or wage		Estimated wage loss		
		Sup. & sales	Prod'n.	Sup. & sales	Prod'n.	Total	Sup. & sales	Prod'n.	Sup. & sales	Prod'n.	Tota
									(000)	(000)	(00
Meat packinghouse,											
small	16	10	40	160	640	800	12,500	7,000	$2,000	$4,480	$6,48
medium	1	40	100	40	100	140	14,000	7,500	560	750	1,31
Slaughter plant,											
small	45	5	20	225	900	1,125	10,000	6,000	2,250	5,400	7,65
medium	4	25	75	100	300	400	14,000	7,500	1,400	2,250	3,65
large	1	50	250	50	250	300	16,000	8,000	800	2,000	2,80
Total	67	-	-	575	2,190	2,765	-	-	$7,010	$14,800	$21,89

1/ Assumes plants have already met Baseline effluent control requirements.

Absorption of Laid-off Employees by Existing Plants

Other area plants would not absorb laid-off employees. Although the meat industry is geographically dispersed, its total employment has been declining during the past ten years as larger, more-highly-automated plants have been built which require fewer employees per thousand pounds of liveweight killed or products processed. In addition, many plants operate only on a single-shift basis at less than 100 percent of capacity. Since the small plants account for, in aggregate, only slightly over 10 percent of the total volume of livestock killed or products processed, the production volume lost by the closing of these plants could be absorbed by remaining plants without their taking on additional employees.

Unemployment Effects on Livestock Feeders

Only minimal unemployment effects on local livestock feeders would be likely, for they have alternative markets to which they can sell their livestock. Though feeders might face higher transportation costs to move their livestock to alternate markets, their markets are so spatially balanced that the transportation differential would not be great. Feeders should realize no unemployment in the livestock feeding industry as a result of the closure of small packinghouses or slaughter plants.

E. Community Effects

A high proportion of meat packinghouses and slaughterhouses are located in relatively small communities, and their closure would have a noticeable economic impact on the community and its surrounding area. Table VI-17 shows the 1972 distribution by city-size of Federally-inspected slaughtering establishments. For the United States, the distribution was as follows:

Size of City (population)	Number of Plants
Over 500,000	114
100,000 - 499,999	138
50,000 - 99,999	61
25,000 - 49,999	62
10,000 - 24,999	133
Under 10,000	431
Total	939

Table VI-17. Meat packing and slaughtering plants, number of federally-inspected plants classified by size of city in which plants are located, August, 1972

State	Plants in cities having a population of: Over 500,000	100,000-499,999	50,000-99,999	25,000-49,999	10,000-24,999	Under 10,000
Alabama	-	2	-	1	1	2
Arizona	4	2				
Arkansas		4	1	1	2	1
California	16	4	7	1	13	17
Colorado	9	3	2	4	3	4
Del.-Md.-D.C.	-	5	-	-	1	4
Florida	-	1	-	-	3	3
Georgia	-	-	2	-	3	3
Hawaii	-	1	-	-	-	-
Idaho	-	-	1	1	3	3
Illinois	9	3	2	5	5	15
Indiana	2	1	1	2	2	5
Iowa	-	2	5	5	2	24
Kansas	4	5	-	2	8	6
Kentucky	-	10	3	2	2	23
Louisiana	1	1	1	1	1	4
Michigan	8	1	-	2	2	4
Minnesota	7	-	-	3	3	48
Mississippi	-	-	1	-	2	4
Missouri	11	2	3	1	2	5
Montana	-	-	4	1	5	20
Nebraska		19	-	1	8	62
Nevada	-	-	1	-	-	1
New England	-	1	2	2	4	9
New Jersey	-	5	-	-	1	6
New Mexico	-	2	-	3	2	8
New York	1	14	3	2	1	18
N. Carolina	-	1	-	1	4	7
N. Dakota	-	-	2	-	2	33
Ohio	6	13	1	5	4	9
Oklahoma	-	3	-	3	3	2
Oregon		5	1	1	2	6
Pennsylvania	7	2	3	1	4	11
S. Carolina	-	2	-	-	3	1
S. Dakota	-	-	2	1	5	-
Tennessee	4	5	-	1	2	2
Texas	16	12	6	4	13	22
Utah	-	2	2	-	-	5
Virginia	-	1	1	2	3	17
Washington	1	3	1	2	5	10
W. Virginia	-	-	-	-	-	1
Wisconsin	8	1	3	1	2	6
Wyoming	-	-	-	-	1	-
Total	114	138	61	62	133	431

This distribution shows that 60 percent of all Federally-inspected slaughtering establishments were located in cities of less than 25,000 population. If over 4,600 very small slaughter plants, which are not Federally-inspected, were added to this tabulation, the proportion of slaughter plants in small communities would be much higher, probably greater than 75 percent.

The closure of a small plant could result in a reduction in payrolls of over $400,000, or approximately 0.65 percent of the total payroll of a city of 25,000 (based on 8,000 employed workers earning $8,000 each). Assuming a multiplier of 3.5, the loss of a small meat plant could reduce the economic base of the community by as much as $1,400,000. A medium-size plant would carry an impact of from $3,000,000 to $5,000,000.

For a city of 8,000 the loss of a small plant would reduce city payrolls by 5 percent with a corresponding reduction in the economic base of the community. In addition to the loss in payrolls, the direct loss in purchases of utilities, transportation services, office supplies and other items by the plant would be felt throughout the community.

Other suppliers, such as spice companies, container manufacturers and equipment manufacturers, are usually located in major metropolitan areas. The closure of small plants would have a minor effect on the business of such suppliers.

Other community impacts would be felt in the loss in taxes which would result from the closure of the plant. In many localities, especially in recent years, packinghouses have been financed by municipal revenue bonds and in such instances, the closing of a plant would result in added burdens for the city budget.

Although livestock feeders in the area served by the packinghouse and the community would be able to find alternative markets for their livestock, the loss of a strong local livestock market forces these producers to ship to more distant markets, incurring a greater transportation cost and resulting in lower net returns at the farm level. However, the impact would be relatively small.

It is impossible to determine precisely the communities in which meat slaughterhouse or packinghouse plant closures would occur; however, as indicated, a high proportion of these plants are in relatively small communities. Over 90 percent of the firms in the meat industry are single-plant firms owning approximately 85 percent of the plants. In addition, virtually all of the small plants would be owned by single-plant firms. Finally, very few small communities would have more than a single meat plant. Such overall data indicate that the number of communities impacted by plant closures would be close (within 10 percent) to the number of plants closed.

Given this situation, the number of communities economically affected by commercial plant closures would be approximately as follows:

Level I, no price increase - 1 community impacted

Level II, no price increase - 67 communities impacted

F. Balance of Payments Effects

The United States, not a major exporter of meats, imports, primarily from Australia and New Zealand, increasingly large amounts of meats, mainly beef.

Meat Imports: Imports of all red meats for the period 1961 through 1972 are shown in Figure VI-1 and Table VI-18. The quantities imported rose from 258 million pounds in 1956 to 2,387 million in 1970, dropped off slightly in 1971, and then rose to a record 2,653 million pounds in 1972.

Of the total of 2,653 million pounds of meat imported in 1972, beef and veal accounted for 1,996 million (75.2%), pork 508 million pounds (19.2%), and lamb, mutton and goat 149 million pounds (5.6%).

The total quantity of red meats net imports in 1972 was equivalent to 7.2 percent of the U.S. production. For beef, imports amounted to 8.7 percent of U. S. production; for pork, 3.7 percent; for lamb and mutton, 27.4 percent. However, for specific classes of meat, e.g., boned, frozen lean beef, imports represent a much more important part of total supplies.

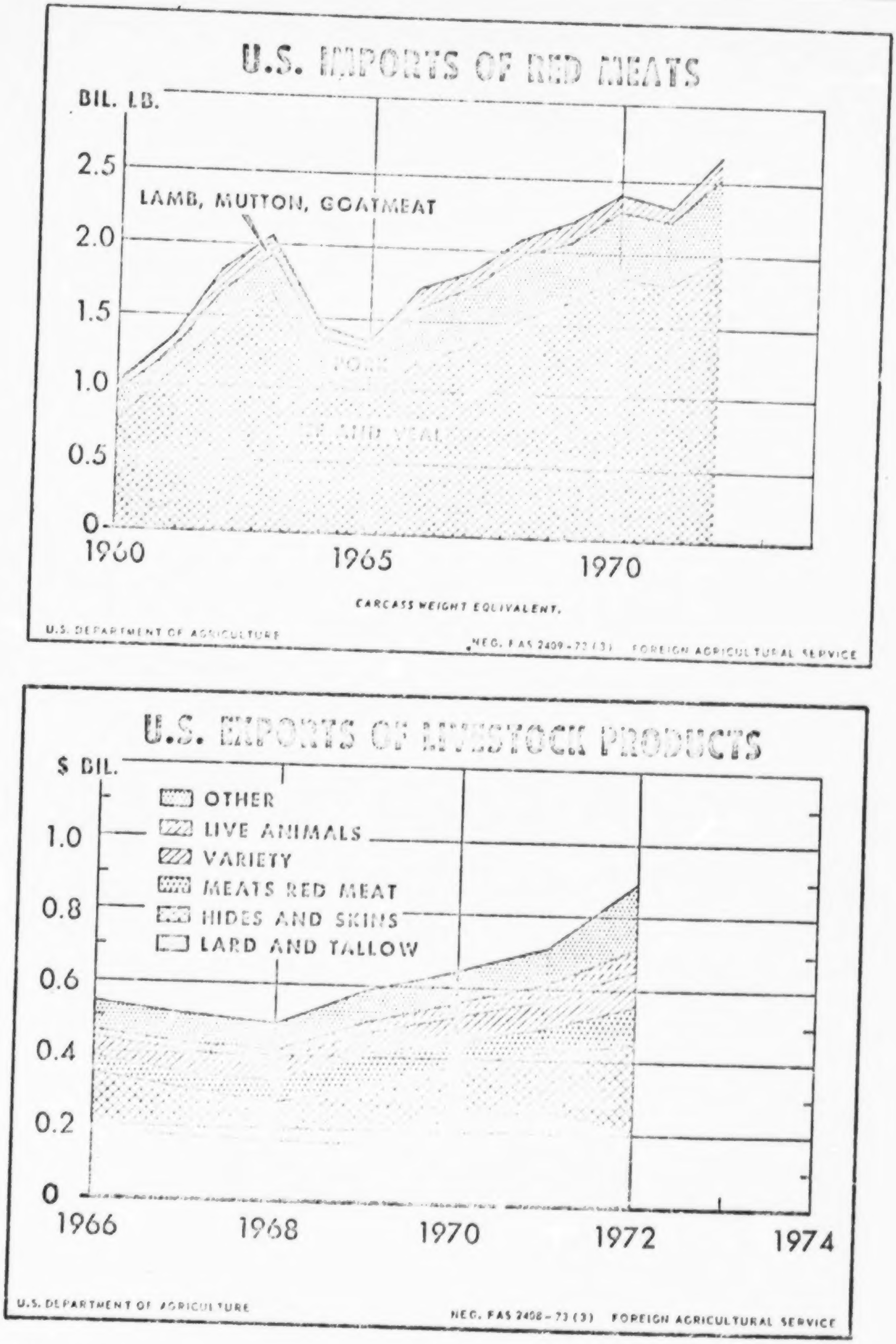

Figure VI-1. U. S. imports of red meats and exports of livestock products, 1960-1972

Reproduced from best available copy.

Table VI-13. U. S. meat imports, by product, 1961-1972[1]

Product	Year											
	1972	1971	1970	1969	1968	1967	1966	1965	1964	1963	1962	1961
Beef												
Boneless fresh or frozen	1,714.5	1,447.4	1,484.2	1,348.9	1,224.7	1,116.0	986.7	734.3	919.2	1,362.8	1,182.9	764.
Fresh or frozen	12.3	22.1	24.3	19.6	26.8	11.7	20.7	29.3	17.2	19.9	18.8	25.
Canned or cured	233.4	264.2	283.7	246.3	248.2	185.8	174.8	159.4	131.3	268.4	212.6	230.
Total	1,960.2	1,733.7	1,792.2	1,614.8	1,499.7	1,313.5	1,182.2	923.0	1,067.7	1,651.1	1,414.3	1,020.
Veal												
Fresh or frozen	36.1	21.8	23.5	25.7	18.3	14.2	22.0	18.8	17.5	26.4	25.5	16.
Pork												
Fresh or frozen	64.4	62.3	55.5	42.9	48.4	47.4	42.0	47.9	39.2	37.0	40.5	36.
Hams & shoulders, canned	403.6	357.4	339.7	314.7	306.5	284.6	267.6	236.7	189.7	165.2	154.9	135.
Other	40.2	38.9	53.2	51.2	61.2	60.5	71.7	48.4	38.5	22.8	20.4	15.
Total	508.2	458.6	448.4	408.8	416.1	392.5	381.3	333.0	267.4	225.0	215.8	187.
Lamb	37.3	38.2	43.5	43.9	22.9	12.3	14.9	12.5	10.4	18.9	13.2	10.
Mutton & Goat	111.2	64.6	79.0	108.4	124.0	108.6	121.1	60.0	68.6	125.8	130.0	89.
Total red meat	2,653.0	2,316.9	2,386.6	2,201.6	2,081.0	1,841.1	1,721.5	1,347.3	1,431.6	2,047.2	1,798.8	1,325.

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[1] Sources: Livestock and Meat Situation, ERS, USDA, various issues.

Imports of beef have nearly tripled since 1960 (Table VI-18), with virtually all of the increase being imports of boneless beef for use in hamburger and other fabricated beef products. Veal imports have remained relatively stable. Pork imports have increased 175 percent with the bulk of the increase represented by imports of canned hams and shoulders. Imports of lamb were relatively constant until 1967, but have tripled since that time. Imports of mutton and goat declined through 1971, but rose sharply in 1972.

In 1972 Australia and New Zealand together supplied 52.0 percent of the total U. S. meat imports, mainly beef, lamb and mutton. Denmark and the Netherlands supplied 12.5 percent, mainly hams and bacon, 6.4 percent came from Canada: 4.7 percent from Argentina and 4.3 percent from Mexico. Other important sources include Poland, Ireland and Brazil (Table VI-19).

In December, 1972, meat-import quotas were suspended for 1973, extending an action taken in June, 1972 to help check rising food costs.

It was expected that the strong economic expansion expected to continue during 1973 would lift the demand for meat, putting "upward pressure" on prices. The suspension of the quotas was designed to moderate those inflationary pressures by encouraging increased imports of meat into the United States.

PL 88-482, thus, prevents a substantial increase in red meat imports and lessens the tendency toward increased meat imports which might result if the wholesale price of meats in the U.S. were forced upward by increased costs associated with water pollution control requirements.

Meat Exports: The U.S. exports of meats are relatively small--168.8 million pounds in 1972--and a substantial part is meat by-products. Total exports equal five-tenths of one percent of the U. S. production and are equal to only 4.8 percent of all meat imports.

Exports go primarily to Canada and the Caribbean although Japan has become an increasingly important market in recent years (Table VI-20). In 1972, Canada took 41.9 percent of total U. S. meat exports; the Bahamas and Jamaica, 9.5 percent; Japan, 28.9 percent; the remaining 19.7 percent was exported to other countries.

Table VI-19. U. S. meat imports, by country of origin, 1961-1972
million pounds product 1/

Country of origin	Year 1972	1971	1970	1969	1968	1967	1966	1965	1964	1963	1962	1961
Australia	747.9	563.8	596.2	565.2	506.4	482.5	467.9	337.7	411.5	582.8	507.6	278.5
New Zealand	286.7	254.2	263.8	247.1	203.8	180.3	156.1	115.0	176.9	250.6	224.8	165.2
Canada	127.5	149.6	144.4	94.6	102.2	81.7	105.0	125.9	80.1	63.8	66.7	77.1
Argentina	94.2	88.4	141.1	130.1	132.6	108.6	80.5	54.8	54.4	87.4	56.0	65.2
Denmark	172.1	137.3	130.4	108.8	112.1	102.4	117.0	85.4	66.5	77.1	71.5	52.7
Netherlands	75.7	82.6	86.7	85.6	82.2	74.6	65.1	46.3	38.2	43.0	43.5	42.1
Mexico	85.9	79.1	78.6	66.5	65.6	47.8	57.1	46.3	48.9	73.0	59.3	53.5
Poland	66.7	54.9	56.0	53.6	55.2	57.2	51.7	53.0	44.0	41.1	40.2	34.8
Ireland	31.3	64.1	69.1	66.2	56.9	80.8	40.0	10.0	20.3	74.2	72.9	64.6
Brazil	48.0	63.1	28.8	34.3	31.7	9.6	18.3	24.7	10.4	10.9	17.2	16.3
All others	253.9	208.5	196.1	178.3	166.4	127.0	108.3	106.9	104.5	110.8	89.8	68.7
Total	1,989.9	1,745.6	1,791.2	1,639.1	1,544.6	1,352.5	1,267.0	1,006.0	1,055.7	1,414.7	1,249.5	918.7

Sources:

1/ Sources: Livestock and Meat Situation, ERS, USDA and Agricultural Statistics, USDA, various issues.

Table VI-20. U.S. meat exports, by country of destination, 1960 - 1972
million pounds product 1/

Country of destination	Year												
	1972	1971	1970	1969	1968	1967	1966	1965	1965	1963	1962	1961	1960
Canada	70.7	42.6	38.9	78.1	50.9	47.8	44.2	39.7	69.8	100.4	51.7	56.2	37.2
Japan	48.7	28.3	17.8	58.6	26.1	1.4	.6	.8	8.6	15.8	.1	.8	3.5
Bahamas	12.2	12.5	12.9	14.5	13.7	11.6	7.6	6.8	6.8	5.1	4.0	4.1	4.3
Jamaica	3.8	4.2	3.7	3.7	5.0	5.0	4.4	5.0	6.6	5.8	4.9	4.6	4.1
All others	33.4	37.4	34.4	35.1	35.4	34.2	39.8	10.7	107.3	44.0	37.1	39.9	
Total	168.8	125.0	107.7	190.0	131.1	100.0	96.6	108.4	199.1	171.1	97.8	105.6	107.6

1/ Sources: Livestock and Meat Situation, ERS, USDA and Agricultural Statistics, USDA, various issues.

In view of the role which PL 88-482 would have in controlling the volume of imports, the major impact which increased costs and prices would have on the balance of payments would be through an increase in prices on the quota tonnage of beef imported.

A recent study, completed by the Economic Research Service, U. S. Department of Agriculture [1] evaluated the effects of alternative beef import policies on U.S. beef and pork production. Under the assumption that PL 88-482 will remain in effect, this study projected (to 1980) a continued increase in prices of U.S. slaughter cattle and hogs, a continuing increase in per capita fed beef consumption, no change in per capita pork supplies, and a gradual decrease in per capita non-fed beef supplies, part of which would be offset by increases in beef imports which are allowed to increase proportionate to increases in domestic beef production. Figure VI-2 shows the trends in selected, relevant variables.

This study further reinforces the conclusion that the impact of increased meat costs resulting from the imposition of water pollution controls on the meat industry would have a negligible effect on the imports and exports of meat and balance of payments associated with the meat industry.

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[1] Effects of Alternative Beef Import Policies on the Beef and Pork Sectors, Agr. Econ. Report No. 233, ERS, USDA, October 1972.

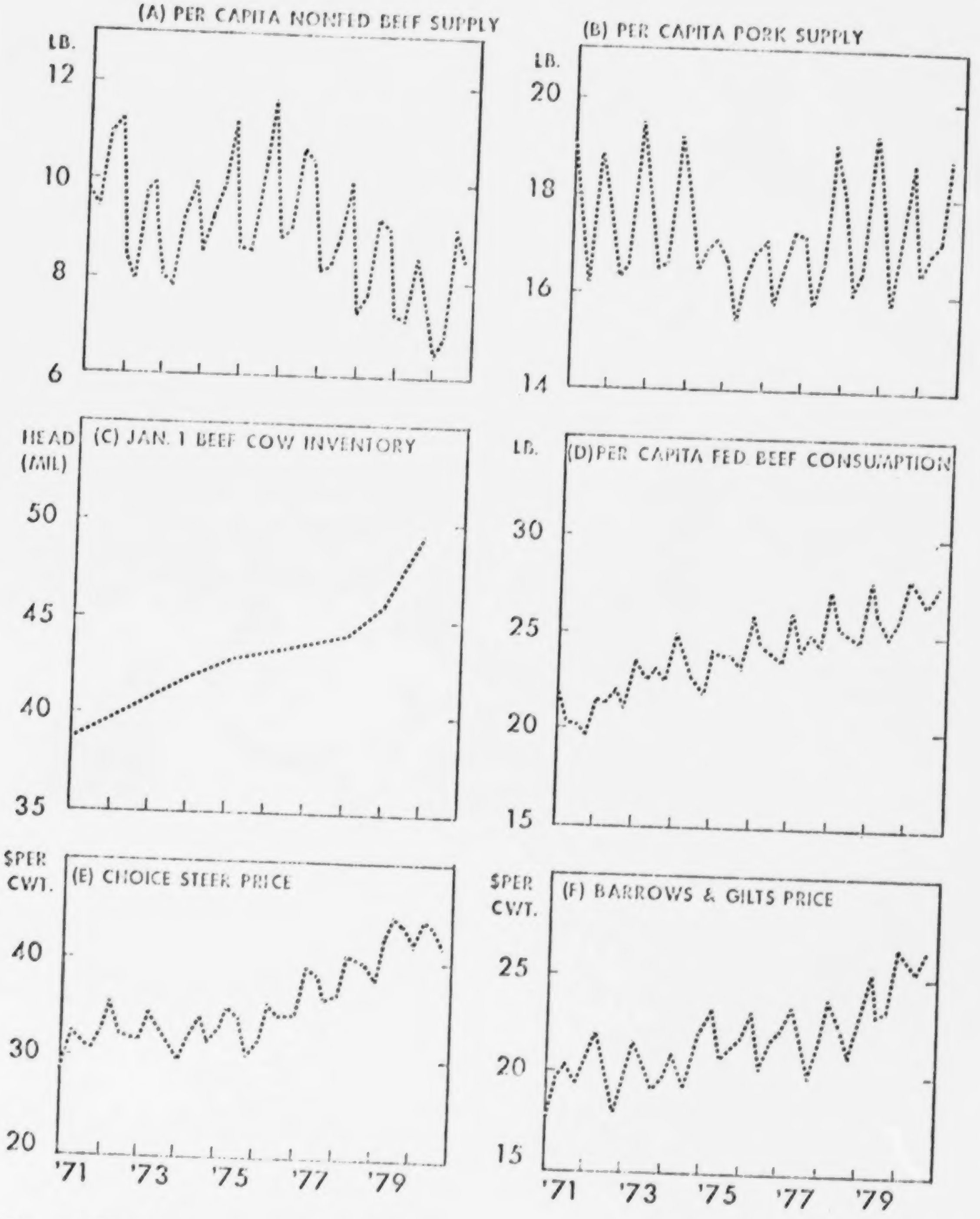

Figure VI-2. Projections of selected beef and pork variables, 1971-1980, assuming a continuation of regulation of beef imports under PL 88-482.

Source: Effects of Alternative Beef Import Policies on the Beef and Pork Sectors, ERS, USDA, Agricultural Economic Report No. 233, October, 1972.

VII. LIMITS OF THE ANALYSIS

A. General Accuracy

The livestock slaughtering and meat packing industry is complex in terms of the number, ownership and geographic distribution of its firms as well as in the sizes and types of the industry's plants.

Detailed data on size distribution by types of plants is not available.

The financial information concerned with industry investments, operating costs and returns was not available for individual plants or firms; consequently, the financial aspects of this impact analysis were, of necessity, based on synthesized costs and returns for "representative" types and sizes of model plants. These costs and returns were developed from a variety of sources which included published research from universities and government agencies, previous studies done by the contractor, information obtained from operating firms in the meat industry, published financial performance data, and discussions with meat processing authorities, meat plant architects and other knowledgeable consultants.

Such data were, wherever possible, corroborated by information from the Internal Revenue Service and such references as Standard and Poors, Dun and Bradstreet. Other sources of data on financial ratios and financial performance were also used as checks on the reasonableness of results obtained in the financial analysis of representative plants.

Throughout the study, an effort was made to evaluate the data and other information used and to update these materials wherever possible. Checks were made with informed sources in both industry and government to help insure that the data and information used were as reliable and as representative as possible. For example, construction costs were checked with established meat plant architects, working capital requirements were checked with the comptroller of a major meat packing firm, rendering equipment costs were based on a firm quote from an equipment supplier for a plant similar to one used in the analysis. The construction of published product prices was checked with the Market News Service, U.S.D.A. which constructs and publishes these price series. Efforts were made to use the latest available data.

Water pollution control costs were furnished by EPA, Effluent Guidelines Division and resulted from costs developed for EPA by North Star Research Insitute. These costs were developed for four "typical" meat processing plants as described earlier in this report. It was necessary to adapt these costs to the types and sizes of model plants used in this analysis. This adaption process required the making of assumptions and adjustments related to these data which are critical to the impact analysis. In addition, it was necessary to make specific assumptions regarding the current status of effluent disposal and treatment in the meat packing industry. These assumptions are described in detail in the "Critical Assumptions" section of this report. The validity of these assumptions and of the effluent control costs which result introduce an additional element of uncertainty and possible inaccuracy. To the extent, however, that the projected pollution control costs are accurate, it is believed that this analysis represents a usefully accurate evaluation of the economic impact of the proposed effluent guidelines on the livestock slaughtering and meat packing industry.

B. Range of Error

Different data series and different sections of the analysis will have different possible ranges of error.

Errors in Data -- The average ranges for estimated data error are as follows:

		Error Range %
1.	Information regarding the organization and structure of the industry, number location and size of plants, and other information descriptive of industry segments	± 10
2.	Price information for products and raw materials	± 3
3.	Cost information for plant investments and operating costs	± 10

4. Financial information concerning the meat industry	± 10
5. Salvage values of plants and equipment.	± 20
6. Effluent treatment costs[1]	
a. Small plants	± 50
b. Medium plants	± 25
c. Large plants	± 10

Errors in Plant Closure Estimates -- Chapter VI presented expected plant closure numbers. Based on the best information available to the contractor, those numbers represent the most probable number of closures. Given the above described error ranges in the supportive data, it is very important to recognize that the closures presented in the impact chapter are subject to similar error ranges. Closure numbers under the best possible and worst possible conditions with respect to supportive data errors are described below. However, it is believed that the possibility of either of these extreme conditions prevailing is unlikely.

Best possible situation: Under the best possible conditions, errors in supportive data would be:

1. 10 percent fewer plants would be direct dischargers.
2. 10 percent fewer plants would be small.
3. 10 percent fewer plants would be slaughter only.
4. Profits would be 25 percent higher than those used in the analysis.
5. Plant salvage values would be 20 percent lower than those used in the analysis.
6. Estimated effluent treatment costs would be too high by:

Small plants	50%
Medium plants	25%
Large plants	10%

7. Capital availability would not be a determining factor.
8. Cost of capital would be 5 percent rather than 6 percent.

Under these best possible conditions, no plants would close under BPT guidelines,and only 20 (all small) plants would be forced to close because of the BAT guidelines.

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[1] Error ranges for effluent treatment costs are the contractor's estimate. EPA did not provide error ranges.

Worst possible situation: Under the worst possible conditions, the errors in the supportive data would be:

1. 10 percent more plants would be direct dischargers.
2. 10 percent more plants would be small.
3. 10 percent more plants would be slaughter only.
4. Profits would be 25 percent lower than those used in the analysis.
5. Plant salvage values would be 20 percent higher than those used in the analysis.

6. Effluent treatment costs would be too low by:

Small plants	50%
Medium plants	25%
Large plants	10%

7. Capital would not be available to finance effluent treatment investment costs unless net present value of future earnings less costs (including treatment costs) exceeds 10 percent of the plant salvage value (prior to installation of BPT and BAT treatment systems).
8. Cost of capital would be 7 percent instead of 6 percent.

Under these worst possible conditions, we feel 25 (all small) plants would be forced to close due to BPT guidelines,and 360 plants due to BAT guidelines.

C. Critical Assumptions

The complex of types and sizes of slaughter and meat packing plants, the processes they carry out, and the effluent control levels and systems proposed to meet these levels, all required making a series of assumptions that were necessary to keep the analysis within manageable limits and to specify "representative" situations which would permit further development of industry-wide impacts. These assumptions fall into seven general areas:

1. Assumptions regarding industry structure
2. Assumptions concerning raw material and product prices
3. Assumptions concerning "representative" model plants
4. Assumptions concerning water pollution control costs
5. Assumptions concerning current status of effluent disposal systems in use by the industry
6. Assumptions concerning the salvage value of plants and equipment
7. Assumptions concerning "shutdown" decisions of slaughters and meat packers.

Industry structure -- The meat industry is both large and complex in its organization. A critical factor affecting this impact analysis is the number and size of plants. Detailed data are not available on volume of slaughter by individual plants. However, a tabulation by state, by size class--large, medium and small--of Federally-inspected plants was made by the Statistical Reporting Service, USDA, especially for this project. In addition to the 1,364 plants under Federal meat inspection in 1973, there were approximately 4,627 plants operating under State inspection. It was assumed that, with few exceptions, these non-Federally inspected plants would fall into the small category, that is, that these plants would kill less than 25 million pounds annually. The distribution of Federally-inspected slaughter plants was based on 1971 data. However, since that time more rigid enforcement of inspection requirements has resulted in an increase in the number of Federally-inspected plants from 766 in 1971 to 1,364 in 1973. Since this increase was primarily due to a shift from the State-inspected to the Federally-inspected status, it was assumed that these new Federally-inspected plants would be in the "small" category.

Price assumptions -- Prices for livestock, meat, meat products and by-products were based on published prices, mainly from the Market News Service, Agricultural Marketing Service, U.S.D.A. Live hog carcass values were estimated by DPRA by applying a commonly-used industry formula to live hog prices. For some specialized, processed products, not quoted by the USDA, prices published in the National Provisioner, a trade magazine, were used. The basis for the development of these prices (e.g. hide and offal values) was discussed with Market News Service representatives responsible for the development of these price series to determine the applicability of the prices to the types of plants and situations used in the analysis. As a result, it is believed that the price series used are generally applicable to the types of plants and products used in the analysis.

"Representative" model plants -- No single plant is "representative" of the complex of types and sizes of plants which constitute the livestock slaughter and meat packing industry. DPRA classified plants as "slaughter only" (no processing) and as meat packinghouses (slaughter and processing). In addition, the slaughter only plants were classed as beef slaughter only and combined beef and pork slaughter. Three sizes of plants--large, medium and small--were specified since it was assumed that there were economies of scale in effluent treatment as well as in slaughtering and meat packing operations. In addition to these type and size classifications, the Effluent Guidelines Division of EPA (through their contract with North Star Research Institute) classified slaughter plants as "simple" and "complex" and meat packinghouses as "low-process" and "high-process" plants. The types and sizes of model plants used are shown in Figure VII-1. This classification results in a total of 18 "model" plants of which 11 were analyzed by DPRA. Those plants not analyzed, e.g., "large, simple slaughter" were excluded because few, if any, plants in this category exist.

It is recognized that this classification of plants does not approach the variety of types and sizes of plants which exist in this industry. In reality, each plant is individually engineered and equipped to meet the requirements of a particular site and location. In addition, the product mix will vary from plant to plant and from time to time within a given plant.

The need to classify plants into a manageable number of types and sizes constitutes a limiting, but necessary assumption. Based on previous studies completed by DPRA, it was known that the smaller plants would be impacted to a greater degree than would those in the medium and large size categories. The model "small" plant analyzed by DPRA was in the upper end (23 million pounds annual kill) of the "small" size category. The very small plants (under 2 million pounds annual kill) were excluded from this analysis of commercial plants since adequate pollution control costs were not available for these plants. However, the probable impact on these very small plants was discussed in the analytical section of the report.

Water pollution control costs -- Data on water pollution control costs were supplied to DPRA by the Effluent Guidelines Division of EPA. Critical limitations regarding the applicability of these water pollution control costs include the following:

a. The classification of the industry into "simple" and "complex" slaughter plants and "low" and "high processing" meat packinghouses according to effluent characteristics may not permit an adequate classification of the industry for the purpose of differentiating the economic impacts of water pollution control costs.

b. Although EPA presented the costs of effluent control as "average total costs," discussions with EPA and North Star led to the conclusion that these costs were in reality "incremental" over a baseline situation which assumed that plants had in-place equipment to control settleable solids and grease and anaerobic + aerobic lagoon systems. Accordingly, DPRA developed a cost series which assumes all plants currently

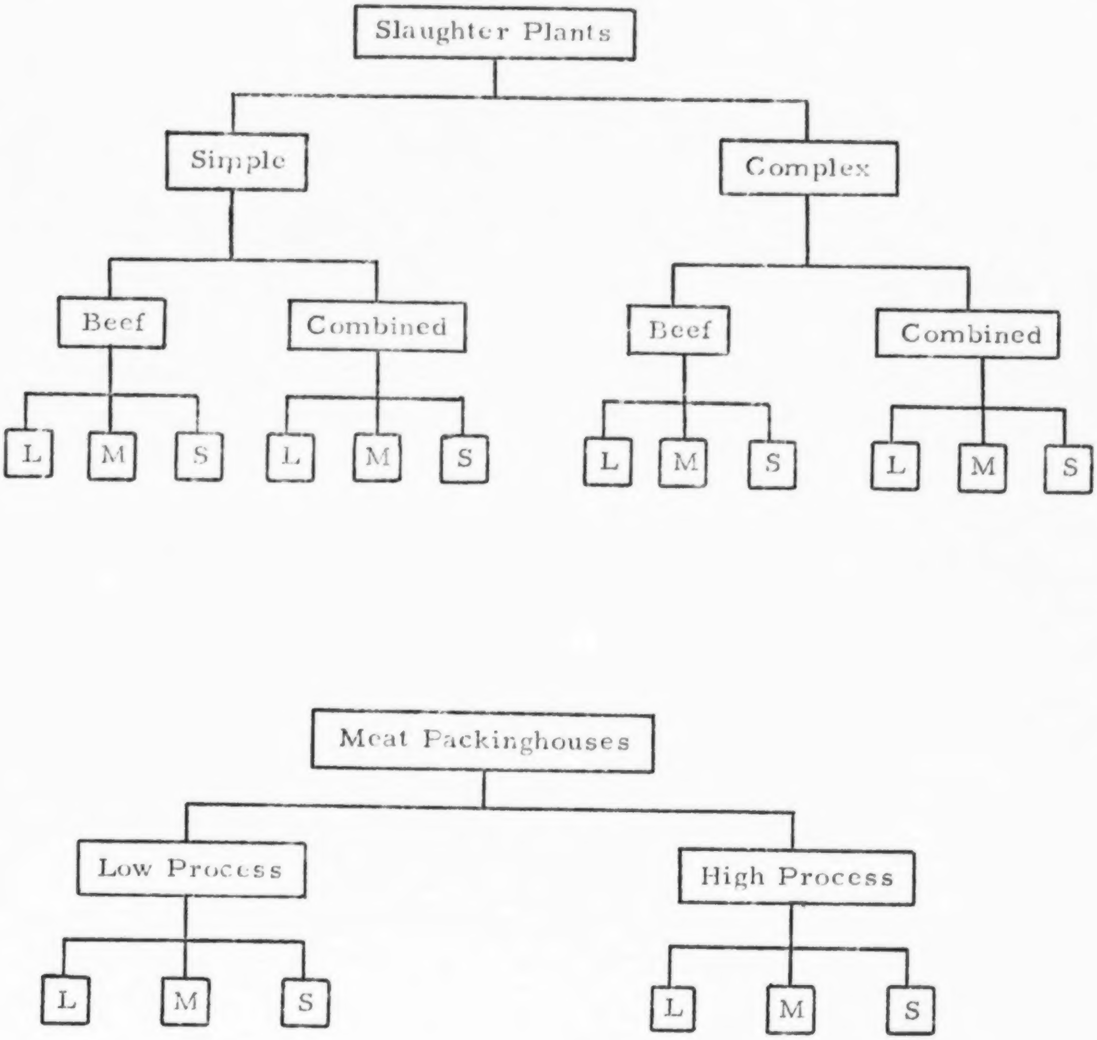
Slaughter Plants
Simple
Complex
Beef
Combined
Beef
Combined
L
M
S
L
M
S
L
M
S
L
M
S
Meat Packinghouses
Low Process
High Process
L
M
S
L
M
S

Figure VII-1. Types and sizes of "model" plants used in impact analysis.

have baseline treatment systems in place. These costs were applied to each of the types and sizes of plants specified in the DPRA report.

c. Wastewater treatment costs, as provided by EPA, were for one size plant, for each of the four plant categories specified in their report. It was necessary to develop basic wastewater flow-relationships for the Baseline and BPT and BAT controls. This required the use of background data to develop the relevant cost curves. Information from EPA and North Star indicated that the capacity-cost relationships would be the same regardless of the type of plant (slaughter-packinghouse) considered. Although data were available for only four plants, cost curves were developed and estimates of investment and annual costs were made for large, medium and small plants as defined in this report. The limited number of observations available does not permit an evaluation of the accuracy of these cost estimates, especially at the lower ranges of waste-flow value.

d. Lacking background information regarding effluent control technologies specifically included in the control cost estimates for each type of plant and control level, DPRA has used the effluent control costs supplied by EPA and has adjusted these costs insofar as possible for the types and sizes of plants analyzed and has updated the costs to 1972 levels by applying appropriate cost index inflators.

Current status of municipal treatment in the industry -- Only limited information is available concerning the current status of effluent control in the meat packing and slaughter industry. This DPRA report assumpted that 85 percent of commercial-sized plants in the meat industry discharge into publicly-owned wastewater treatment systems and that 50 percent of the very small processors and frozen food locker plants which slaughter discharge into municipal systems.

Salvage values -- Salvage values of buildings, equipment and land will vary greatly from one location to another and by the type and condition of structures and equipment.

In order to avoid problems inherent in any attempt to establish differential salvage values, a set of "standard" assumptions concerning salvage values as developed.

a. Land was salvaged at its 1972 value.
b. Buildings and equipment were salvaged at a net amount equivalent to 10 percent of their 1972 replacement value.
c. Net operating capital was recovered intact.

"Shutdown" decisions -- The general purpose of the "shutdown" model was to examine the profitability of the model plants before and after the imposition of effluent limitation guidelines, to determine the resulting profitability of forced closures, and to calculate the price changes required to cover the added effluent control costs.

The model required assumptions relative to numerous factors.

These assumptions are described in detail in previous sections of this report. Assumptions used, while arbitrary, were made in accordance with the estimates of conditions prevailing in the livestock slaughter and meat packing industries.